Federal Energy Regulatory Commission
Office of Energy Projects
Washington, DC 20426

Aguirre Offshore GasPort Project
Final Environmental Impact Statement

Aguirre Offshore GasPort, LLC

Volume I

Docket Nos. CP13-193-000 and PF12-4-000
FERC/EIS-0253F

Cooperating Agencies:

U.S. Environmental Protection Agency
U.S. Coast Guard
Puerto Rico Permits Management Office
U.S. Department of Energy
U.S. Department of Transportation
Puerto Rico Environmental Quality Board
Puerto Rico Planning Board
Puerto Rico Department of Natural and Environmental Resources
Puerto Rico Department of Health
U.S. Department of Agriculture

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February 2015

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426

OFFICE OF ENERGY PROJECTS

In Reply Refer To:
OEP/DG2E/Gas 4
Aguirre Offshore Gasport, LLC
Aguirre Offshore GasPort Project
Docket No. CP13-193-000

TO THE PARTY ADDRESSED:

The staff of the Federal Energy Regulatory Commission (FERC or Commission) has prepared a final environmental impact statement (EIS) for the Aguirre Offshore GasPort Project (Project), proposed by Aguirre Offshore GasPort, LLC (Aguirre LLC), a wholly owned subsidiary of Excelerate Energy, LP in the above-referenced docket. Aguirre LLC is seeking authorization from the FERC to develop, construct, and operate a liquefied natural gas (LNG) import terminal off the southern coast of Puerto Rico.

The final EIS assesses the potential environmental effects of the construction and operation of the Aguirre Offshore GasPort Project in accordance with the requirements of the National Environmental Policy Act (NEPA). Construction and operation of the Project would result in mostly temporary and short-term environmental impacts; however, some long-term and permanent environmental impacts would occur. The FERC staff concluded that approval of the proposed Project, with the mitigation measures recommended in the EIS, would result in limited adverse environmental impacts.

The U.S. Environmental Protection Agency (EPA), U.S. Coast Guard, U.S. Department of Transportation, U.S. Department of Energy, U.S. Department of Agriculture, Puerto Rico Permits Management Office, Puerto Rico Environmental Quality Board, Puerto Rico Planning Board, Puerto Rico Department of Natural and Environmental Resources, and Puerto Rico Department of Health participated as cooperating agencies in the preparation of the EIS. Cooperating agencies have jurisdiction by law or special expertise with respect to resources potentially affected by the proposal, and participate in the NEPA analysis. In addition, other federal, state, and local agencies may use this EIS in approving or issuing permits for all or part of the proposed Project. Although the cooperating agencies provided input to the conclusions and recommendations presented in the final EIS, the agencies will present their own conclusions and recommendations in their respective Records of Decision for the Project.

The U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, and National Oceanic and Atmospheric Administration, National Marine Fisheries Service also provided assistance in preparing this EIS as permitting and consulting agencies.

The Project is being developed in cooperation with the Puerto Rico Electric Power Authority (PREPA) for the purpose of receiving, storing, and regasifying the LNG to be acquired by PREPA; and delivering natural gas to PREPA's existing Aguirre Power Complex (Aguirre Plant) in Salinas, Puerto Rico. The Project will help diversify Puerto Rico's energy sources, allow the Aguirre Plant to meet the EPA's Mercury and Air Toxics Standard rule, reduce fuel oil barge traffic in Jobos Bay, and contribute to price stabilization for power in the region. The final EIS addresses the potential environmental effects of the construction and operation of the following Project facilities:

- an offshore berthing platform;
- an offshore marine LNG receiving facility;
- a Floating Storage and Regasification Unit moored at the offshore berthing platform;
- visiting LNG carriers; and
- a 4.0-mile-long (6.4 kilometer) subsea pipeline connecting the Offshore GasPort to the Aguirre Plant.

The FERC staff mailed copies of the final EIS to federal, state, and local government representatives and agencies; elected officials; environmental and public interest groups; other interested individuals and groups; newspapers and libraries in the Project area; and parties to this proceeding. The final EIS was also translated in Spanish. Paper copy versions of this EIS in English were mailed to those specifically requesting them; all others received a CD version. To accommodate translation, paper copy and CD versions of this EIS in Spanish are scheduled to be mailed out about two weeks after the English version. In addition, the final EIS is available for public viewing on the FERC's website (www.ferc.gov) using the eLibrary link. A limited number of copies are available for distribution and public inspection at:

Federal Energy Regulatory Commission
Public Reference Room
888 First Street NE, Room 2A
Washington, DC 20426
(202) 502-8371

Additional information about the Project is available from the Commission's Office of External Affairs, at **(866) 208-FERC,** or on the FERC website (www.ferc.gov) using the eLibrary link. Click on the eLibrary link, click on "General Search," and enter the docket number excluding the last three digits in the Docket Number field (i.e., CP13-193). Be sure you have selected an appropriate date range. For assistance, please contact FERC Online Support at FercOnlineSupport@ferc.gov or toll free at (866) 208-3676; for

TTY, contact (202) 502-8659. The eLibrary link also provides access to the texts of formal documents issued by the Commission, such as orders, notices, and rulemakings.

In addition, the Commission offers a free service called eSubscription that allows you to keep track of all formal issuances and submittals in specific dockets. This can reduce the amount of time you spend researching proceedings by automatically providing you with notification of these filings, document summaries, and direct links to the documents. Go to http://www.ferc.gov/docs-filing/esubscription.asp.

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II. RESPONSES TO COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

TECHNICAL ACRONYMS

ACHP	Advisory Council on Historic Places
Acropora BRT	Acropora Biological Review Team
Aguirre LLC	Aguirre Offshore GasPort, LLC
AQCR	Air Quality Control Region
ASD	Automatic Shut Down
ASME	American Society of Mechanical Engineers
ATBA	area to be avoided
ATWS	additional temporary workspace
BA	Biological Assessment
BTU/ft^2-hr	British thermal units per square foot per hour
CAA	Clean Air Act
CariCOOS	Caribbean Coastal Ocean Observing System
CEQ	Council on Environmental Quality
CFMC	Caribbean Fishery Management Council
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COC	Certificate of Compliance
COE	U.S. Army Corps of Engineers
COTP	Captain of the Port
CSP	Cost Sharing Plan
CWA	Clean Water Act
CZMA	Coastal Zone Management Act of 1972
CZMP	Coastal Zone Management Program
dB	decibels
dBA	decibels on the A-weighted scale
DDT	dichlorodiphenyltrichloroethane
DFDE	dual-fuel diesel electric
DNER	Puerto Rico Department of Natural and Environmental Resources
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EBRV	Energy Bridge Regasification Vessel
ECA	Emission Control Area
EEZ	U.S. Exclusive Economic Zone
EFH	essential fish habitat
EI	Environmental Inspector
EIA	U.S. Energy Information Administration
EIS	environmental impact statement

EPA	U.S. Environmental Protection Agency
EQB	Puerto Rico Environmental Quality Board
ERL	effects range low
ERM	effects range median
ERP	Emergency Response Plan
ESA	Endangered Species Act
FEED	Front End Engineering Design
FERC	Federal Energy Regulatory Commission
FMP	Fishery Management Plans
FR	Federal Register
FSRU	Floating Storage and Regasification Unit
FWS	U.S. Fish and Wildlife Service
GHG	greenhouse gas
GWP	global warming potential
H1H	highest first highest
HAP	hazardous air pollutants
HAZID/HAZOP	Hazard Identification and Operability Study
HDD	horizontal directional drill
IMO	International Marine Organization
ISPS Code	International Ship and Port Facility Security Code
JBNERR	Jobos Bay National Estuarine Research Reserve
kPa	kilopascal
kW	kilowatt
kW/m^2	kilowatt per square meter
L_{dn}	day-night noise level
L_{eq}	equivalent sound level
LFL	lower flammability limit
LNG	liquefied natural gas
LOI	Letter of Intent
LOR	Letter of Recommendation
MARPOL	International Convention for Prevention of Pollution from Ships
MATS rule	Mercury and Air Toxics Standard
MBTA	Migratory Bird Treaty Act
MGPS	marine growth preventative system
MMBtu	million British thermal units per hour
MMO	marine mammal observer
MMPA	Marine Mammal Protection Act of 1972
MMscf/d	million standard cubic feet per day
MP	milepost
MSA	Magnuson-Stevens Fishery Conservation and Management Act

mtpy	metric tons per year
MW	megawatt
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NERRS	National Estuarine Research Reserve System
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NGA	Natural Gas Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrous oxides
NPDES	Nation Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NSA	noise-sensitive area
NSPS	New Source Performance Standards
NSR	New Source Review
NVIC	Navigation and Vessel Inspection Circular
NWI	National Wetlands Inventory
O_2	oxygen
OCD	Offshore and Coastal Dispersion Model
OEP	Office of Energy Projects
P&ID	piping and instrumentation diagram/drawing
Pa	pascals
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl congener
PHMSA	Pipeline and Hazardous Materials Safety Administration
PI	point of inflection
PIC	Vessel Operator's Person in Charge
Plan	*Upland Erosion Control, Revegetation and Maintenance Plan*
PM_{10}	particulate matter (10 micrometers or less)
$PM_{2.5}$	particulate matter (2.5 micrometers or less)
PMO	Permits Management Office
PRDH	Puerto Rico Department of Health
PREPA	Puerto Rico Electric Power Authority
Procedures	*Wetland and Waterbody Construction and Mitigation Procedures*
PRPB	Puerto Rico Planning Board
PRSC34	Puerto Rico Coastal Segmentation Unit, South Region Coastal Shoreline

PRWQSR	Puerto Rico Water Quality Standards Regulation
PSD	Prevention of Significant Deterioration of Air Quality
PSV	port service vessel
Reclamation	Bureau of Reclamation
RHA	Rivers and Harbors Act
RPT	rapid phase transition
RUS	Rural Utilities Service
SA	spectral acceleration
SAV	submerged aquatic vegetation
SCR	selective catalytic reduction
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
SOLAS	International Convention for the Safety of Life at Sea
SOPEP	Shipboard Oil Pollution Emergency Plan
SPA	Special Planning Area
UFL	upper flammability limit
USC	United States Code
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
VOC	volatile organic compounds
WSA	Waterway Suitability Assessment
WSR	Waterway Suitability Report

EXECUTIVE SUMMARY

INTRODUCTION

On April 17, 2013, Aguirre Offshore GasPort, LLC (Aguirre LLC), a wholly owned subsidiary of Excelerate Energy, LP (Excelerate Energy), filed an application with the Federal Energy Regulatory Commission (Commission or FERC) under Section 3 of the Natural Gas Act (NGA) and Part 153 of the Commission's regulations. The application was assigned Docket No. CP13-193-000, and a Notice of Application was issued on April 30, 2013, and noticed in the Federal Register on May 6, 2013. Aguirre LLC is seeking authorization from the FERC to develop, construct, and operate a liquefied natural gas (LNG) import terminal off the southern coast of Puerto Rico.

The purpose of the environmental impact statement (EIS) is to inform FERC decision-makers, the public, and the permitting agencies about the potential adverse and beneficial environmental impacts of the proposed Aguirre Offshore Gasport Project (Project) and its alternatives, and recommend mitigation measures that would reduce adverse impacts to the extent practicable. We [1] prepared this final EIS to assess the environmental impacts associated with construction and operation of the Project as required under the National Environmental Policy Act (NEPA) of 1969, as amended. Our analysis was based on information provided by Aguirre LLC and further developed from data requests, field investigations, scoping, literature research, and contacts with or comments from federal, state, and local agencies, and individual members of the public.

The FERC is the lead agency for the preparation of the EIS. The FERC invited agencies to participate in the NEPA review as cooperating agencies. [2] The U.S. Environmental Protection Agency (EPA), U.S. Coast Guard (USCG), U.S. Department of Transportation (DOT), U.S. Department of Energy (DOE), U.S. Department of Agriculture (USDA), Puerto Rico Permits Management Office, Puerto Rico Environmental Quality Board (EQB), Puerto Rico Planning Board, Puerto Rico Department of Natural and Environmental Resources (DNER), and Puerto Rico Department of Health have participated as cooperating agencies. [3]

PROPOSED ACTION

The Project is being developed in cooperation with the Puerto Rico Electric Power Authority (PREPA) for the purpose of receiving, storing, and regasifying LNG to be acquired by PREPA; and delivering natural gas to PREPA's existing Aguirre Power Complex (Aguirre Plant) in Salinas, Puerto Rico. The Project would include the construction and operation of an offshore marine LNG receiving facility (Offshore GasPort) and a 4.0-mile-long (6.4 kilometers [km]) subsea pipeline connecting the Offshore GasPort to the Aguirre Plant. A Floating Storage and Regasification Unit (FSRU) would be moored at the offshore berthing platform on a semi-permanent basis. Ships would dock at the offshore berthing platform and deliver LNG to the FSRU. Both the ships and the FSRU would be under the jurisdiction of the USCG. The LNG receiving facility would be located approximately 3 miles (4.8 km) off the southern coast of Puerto Rico, about 1 mile (1.6 km) outside of Jobos Bay, near the towns of Salinas and Guayama. Aguirre LLC is also proposing to utilize a construction office, contractor staging area, and existing access construction dock within the Aguirre Plant property.

The purpose of the Project is to provide LNG storage capacity and sustained deliverability of natural gas directly to the Aguirre Plant, which would facilitate PREPA's conversion of the Aguirre

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1 "We," "us," and "our" refer to the environmental staff of the Federal Energy Regulatory Commission's Office of Energy Projects.

2 A cooperating agency is an agency that has jurisdiction over all or part of a project area and must make a decision on a project, and/or an agency that provides special expertise with regard to environmental or other resources.

3 The U.S. Army Corps of Engineers withdrew as a cooperating agency on January 28, 2015.

Plant from fuel oil only to a dual-fuel generation facility, capable of burning diesel and natural gas for the combined cycle units and fuel oil and natural gas for the thermoelectric plant. The Project would contribute to the diversification of energy sources in Puerto Rico, allow the Aguirre Plant to meet the requirements of the EPA's Mercury and Air Toxics Standard rule, reduce fuel oil barge traffic in Jobos Bay, and contribute to energy price stabilization in the region. Aguirre LLC is proposing to place the Project facilities in service in 2016.

AGENCY AND PUBLIC REVIEW AND COMMENT OPPORTUNITIES

On December 21, 2011, Aguirre LLC filed a request with the FERC to implement the Commission's pre-filing process for the Project. On January 1, 2012, we granted Aguirre LLC's request and established a pre-filing docket number (PF12-4-000) in which to place information filed by Aguirre LLC, comments provided by stakeholders, and documents issued by the FERC and other agencies into the public record. Aguirre LLC held three informational open houses in February 2012, September 2012, and May 2013. The purpose of the open houses was to provide the general public with information about the Project and to give them an opportunity to ask questions and express their concerns. We participated in the open houses and provided information regarding the Commission's environmental review process to interested stakeholders. The substantive questions and concerns raised by the public at the open houses are addressed in the draft EIS.

On February 28, 2012, we issued a *Notice of Intent to Prepare an Environmental Impact Statement for the Planned Aguirre Offshore GasPort Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meetings*. The notice was published in the Federal Register on March 5, 2012, and mailed to more than 130 interested parties, including federal, state, and local government representatives and agencies; elected officials; environmental and public interest groups; other interested parties; and local libraries and newspapers. The notice briefly described the Project and the EIS process, provided a preliminary list of environmental issues identified by us, invited written comments on the environmental issues that should be addressed in the EIS, listed the date and location of two public scoping meetings to be held in the Project area, and established a closing date for receipt of comments of March 30, 2012. We received approximately 25 comment letters from various stakeholders, including the U.S. Fish and Wildlife Service (FWS); National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS); National Park Service; Governor of the Commonwealth of Puerto Rico; PREPA; Puerto Rico Federal Affairs Administration; Puerto Rico Pilotage Commission; Government Development Bank of Puerto Rico; Comité Diálogo Ambiental; the Center for Biological Diversity; and Captain Jimmy Vazquez-Aran.

Our public scoping meetings provided an opportunity for agencies, stakeholders, and the general public to learn more about the Project and participate in the environmental analysis by commenting on the issues to be addressed in the draft EIS. The first meeting was in the Town of Guayama on March 20, 2012; the second meeting was in the Town of Salinas on March 21, 2012. Approximately 30 people attended the meeting in Guayama and 45 people attended the meeting in Salinas. The transcripts of the public scoping meetings, summaries of the interagency scoping meetings, and all written scoping comments are part of the public record for the Project and are available for viewing on the FERC internet website (http://www.ferc.gov).[4]

[4] Using the "eLibrary" link, select "General Search" from the eLibrary menu, enter the desired date range and Docket Number (i.e., CP13-193 or PF12-4), and follow the instructions.

We coordinated several interagency scoping meetings in the Project area to solicit comments and concerns about the Project from other permitting and resource agencies. These meetings were held in March 2012, May 2012, September 2012, May 2013, November 2013, and June 2014. We also conducted a field visit with Aguirre LLC on February 2, 2012, to review the proposed locations and construction methods of the onshore and offshore facilities. On September 5, 2012; February 18, 2013; April 15, 2013; and December 4, 2013, we issued Project Updates, which outlined the status of the environmental review process and included a summary of the issues identified to date.

On August 7, 2014, we issued a *Notice of Availability of the Draft Environmental Impact Statement for the Proposed Aguirre Offshore GasPort Project*. This notice, which was published in the Federal Register, listed the dates, times, and locations for public comment and established a closing date of September 29, 2014 for receiving comments on the draft EIS. Copies of the draft EIS, in English and Spanish, were mailed to federal and state agencies, interested parties, and organizations. The notice was advertised in three local newspapers. In addition, color flyers announcing the meetings were placed in various venues (post office, marina, grocery stores, etc.) to ensure the general public was aware of the meetings. The first meeting was held in Guayama on September 9, 2014, and the second meeting was held in Salinas on September 10, 2014. These meetings were held jointly with the Puerto Rico Permits Management Office and were conducted in English and Spanish using a live translation service. Sixteen speakers gave comments at the public comment meetings.

The public comment period for receiving written comments on the draft EIS closed on September 29, 2014. We received 27 written comment letters that included over 300 individual comments. Written comments were received from federal, state, and local agencies; companies and organizations; individuals; and Aguirre LLC. The transcripts from the public comment meetings and the written comment letters are available for viewing on the FERC's website (http://www.ferc.gov). All substantive comments related to environmental issues received on the draft EIS, within a timeframe that allowed for their review, are addressed in Volume I of the EIS; our responses are provided in Volume II, including comments submitted outside of the designated period. Substantive changes in the final EIS are indicated by vertical bars that appear in the margins. These changes were made both in response to substantive comments received on the draft EIS and as a result of updated information that became available after the issuance of the draft EIS.

One of the main project developments that came about after the issuance of the draft EIS was notice by the DOT's Pipeline and Hazardous Materials Safety Administration (PHMSA) that Aguirre LLC's proposed pipeline design was not in compliance with DOT's pipeline standards in Title 49 Code of Federal Regulations (CFR) Part 192 (49 CFR 192), which prompted a meeting between PHMSA, Aguirre LLC, and FERC on August 22, 2014.[5] Following several attempts by Aguirre LLC to modify its pipeline design to meet DOT's pipeline standards, PHMSA issued a formal letter on October 31, 2014, explaining that the proposed pipeline design remained out of compliance with 49 CFR 192.327(f), requiring "burial below natural grade sea bottom or an alternative equivalent protection system from hazards." On December 3, 2014, Aguirre LLC filed its modified pipeline design to include burial of the offshore pipeline to at least below natural bottom in some locations and to three feet (0.9 m) to the top of the pipeline in other locations, with the exception of approximately 1,700 feet (518 m) through the area across the Boca del Infierno pass where Aguirre LLC proposes to direct lay over the coral reef with protective concrete mats placed over the pipeline. The modified pipeline design meets the requirements of 49 CFR 192.

[5] A summary of the meeting can be found in Docket No. CP13-193-000 using the "eLibrary" link under "Documents and Filing" on FERC's website www.ferc.gov.

ENVIRONMENTAL IMPACTS AND MITIGATION

We evaluated the Project impacts on geology; soils and sediments; water resources; wetlands; vegetation; wildlife and aquatic resources; threatened, endangered, and special status species; land use, recreation, and visual resources; socioeconomics (including transportation and traffic); cultural resources; air quality and noise; and reliability and safety. We also considered the cumulative impacts of this Project with past, current, and reasonably foreseeable future actions in the Project area.

Overall, construction of the Project as proposed would temporarily disturb approximately 131.4 acres (135.2 cuerdas) of land, surface water, and the seafloor, including 1.5 acres (1.5 cuerdas) of land within the existing Aguirre Plant property.[6] As proposed, the construction of the offshore facilities, including the Offshore GasPort, subsea interconnecting pipe, and lay barge construction areas, would directly impact approximately 129.9 acres (133.7 cuerdas) of the seafloor. Operation of the offshore facilities would permanently impact approximately 22.9 acres (23.5 cuerdas) of seafloor.

Important issues identified as a result of our analyses, scoping comments, and agency consultations include impacts on marine wildlife, essential fish habitat, and benthic species; impacts on threatened or endangered species; impacts on land use and recreation; and air and noise impacts. Where necessary, we are recommending additional mitigation measures to minimize or avoid these and other impacts. Section 5.2 of the EIS contains our conclusions and a compilation of our recommended mitigation measures.

Geologic Resources

The proposed Offshore GasPort and pipeline construction and operation would have minimal impacts on the geologic resources of the area. However, some hazards such as seismic ground motion, liquefaction events, wind and wave loadings, and tsunamis could impact the Project during operation. Therefore, we are recommending that Aguirre LLC file a revised seismic hazard analysis report, additional studies on seafloor slope angles and liquefaction potential along the pipeline alignment, offshore wave analysis, marine terminal structure and pile foundation design and calculations, seismic specifications used in conjunction with the procuring equipment, quality control procedures that would be used for design and construction, and identification of an inspector employed by Aguirre LLC to observe the construction of the Project and furnish inspection reports. In addition, we are recommending that Aguirre LLC conduct and file a detailed geotechnical analysis with its Implementation Plan, to assess the feasibility of using the horizontal directional drill (HDD) method to bore under the Boca del Infierno pass.

Soils and Sediments

Construction activities, including the installation of the subsea pipeline, temporary piles, and permanent structures at the Offshore GasPort, would result in the resuspension of seafloor sediment into the water column. When suspended during construction, the fine silt particles would descend through the water column relatively slowly and could travel hundreds of yards (hundreds of meters) under mean current speeds due to the spatial and temporal asymmetry of the tidal currents. To ensure that impacts associated with the resuspension, transport, and redeposition of sediments disturbed during construction activities are addressed, we conducted an independent analysis of sediment transport during construction and operations of the subsea pipeline, as proposed. The results of the sediment transport analysis concluded that maximum suspended sediment concentrations would reach 1,620 milligrams per liter in the vicinity of Aguirre LLC's proposed hand jet/suction pump pipe burying activities. However,

[6] Direct impacts related to construction of the subsea pipeline would be different if either our recommendation for an alternate construction method or an alternate pipeline route are adopted by the Commission. See our recommendations and related discussion in sections 3.6 and 4.5.2.4 of this EIS.

concentrations would decrease to 50 milligrams per liter or less within approximately 100 feet (30 meters) of a majority of the construction area. Deposition rates would be highest along the pipeline, with a maximum deposition of approximately 0.7 inches (1.7 centimeters), but would be reduced to less than 0.04 inch (1 millimeter) within approximately 200 feet (61 meters) of a majority of the construction area. Aguirre LLC proposes to use turbidity curtains to minimize sediment transport during the pipe burial procedures. Thus, construction activities in Jobos Bay are not expected to cause widespread or significant impacts through resuspension of surficial sediments. The existing benthic infaunal community is regularly exposed to surficial sediments, and the temporary resuspension is not expected to create a significant impact.

Water Resources

Construction activities of the Offshore GasPort and pipeline would cause the displacement of sediments on the seafloor and the resuspension of sediments into the water column. Sediment disturbed during construction would also be resuspended in the water column and transported by currents. The effects of the construction activities on turbidity levels would vary with the length and severity of disturbance, grain size composition, and resettling rates. As discussed above, we conducted an independent analysis of sediment transport during Project construction and operations and concluded that construction activities in Jobos Bay are not expected to cause widespread or significant impacts through resuspension of surficial sediments.

Spills or leaks of hazardous materials (e.g., fuel, lubricants) from equipment working in the onshore areas could also result in adverse impacts on water resources. Construction contractors and port operations personnel would be required to comply with all laws and regulations. We are recommending that Aguirre LLC file a site-specific spill prevention and control plan for the construction and operation phases of the Project (onshore and offshore) prior to construction.

Vegetation Resources

Based on the sparse vegetation within the proposed onshore temporary workspace area, no significant impacts on terrestrial vegetation resulting from construction or operation of the Project are anticipated.

Submerged aquatic vegetation is the most common benthic cover type in Jobos Bay. Seagrass is the dominant cover in approximately 30 percent of the bay; macroalgae (seaweed) is the dominant cover in an additional 20 percent. Seagrasses provide food and shelter to commercial and recreational fishery species as well as invertebrates and birds. Seagrasses also reduce wave and current action and improve water clarity and quality. Both seagrass and macroalgae are distributed throughout Jobos Bay, providing habitat for commercially and recreationally important fish and invertebrates. To ensure that impacts on seagrass are minimized and/or properly mitigated for the authorized pipeline route, we have recommended that Aguirre LLC finalize its Benthic Resources Mitigation Plan in consultation with the NMFS, FWS, DNER, and other appropriate agencies.

Wildlife Resources

Temporary impacts on marine wildlife habitats from the Offshore GasPort and subsea pipeline, as proposed, include 22.5 acres (23.3 cuerdas) of seagrass, 80.8 acres (83.1 cuerdas) of macroalgae, and 6.2 acres (6.4 cuerdas) of coral reef habitat. Construction of the Project would result in short-term adverse impacts on a rich and diverse assemblage of wildlife species including manatees, sea turtles, reef fish, sharks, corals, and invertebrates found within these habitats. The most likely effects would be the general avoidance or isolation from preferred habitat due to construction activities. Marine mammals and sea turtles would also be exposed to an elevated risk of vessel strikes during the construction period because the number of vessels present in the area would increase from current traffic levels.

Hydrostatic testing involves filling pipelines with water, performing pressure tests in accordance with applicable regulations, and discharging the test water following completion of the test. Aguirre LLC would withdraw the water used for testing from Jobos Bay or the Caribbean Sea, depending on the section of pipeline being tested. NMFS raised concerns regarding entrainment of fish during this process. To ensure that the entrainment of fish and other organisms is minimized or avoided during hydrostatic testing, we are recommending that Aguirre LLC consult with NMFS regarding the type of screen (e.g., wedge-wire) that would be used for water withdrawals during construction.

The Offshore GasPort and subsea pipeline would create a permanent impact on marine wildlife habitat. These permanent impacts would include approximately 2.9 acres (3.0 cuerdas) of seagrass, 19.2 acres (19.8 cuerdas) of macroalgae, 0.6 acre (0.6 cuerda) of reef, and 0.2 acre (0.2 cuerda) of sand/mud. The Project would result in direct impacts from mortality of coral colonies within the footprint of the pipeline, as proposed, across the coral reef and unconsolidated hardbottom, as well as indirect impacts resulting from shading of patch reef below the Offshore GasPort (including the FSRU and LNG carrier) and degradation of seagrass and macroalgae foraging habitats. The FSRU and LNG carriers stationed at the Offshore GasPort would also locally impact wildlife resources from thermal plume, plankton entrainment, noise, and lighting. Aguirre LLC would place concrete mats over the pipeline in areas where the pipe is not buried and in areas where the pipe has a bend. To ensure that the concrete mats remain securely on the seafloor during Project operations, we have recommended that Aguirre LLC file with its Implementation Plan a description of the measures that would be used, in addition to lowering the mat edges, to secure all the concrete mats to the seafloor. We have also recommended that Aguirre LLC maintain the pipeline segments afloat until ready to lay the pipe to minimize seafloor disturbance.

Environmental regulatory agencies, including NMFS, have expressed concern over impacts on protected coral species and habitat along the subsea pipeline route, specifically in the area of the Boca del Infierno pass.[7] Aguirre LLC's proposed direct lay construction method through the Boca del Infierno pass would permanently adversely impact the protected coral species and habitat located in the area. We agree with NMFS that impacts on federally listed corals within the Boca del Infierno pass should be avoided.

As previously mentioned, Aguirre LLC has prepared a Benthic Resources Mitigation Plan. We are recommending that, prior to construction, Aguirre LLC consult with the respective agencies to finalize the Benthic Resources Mitigation Plan to: 1) address the currently proposed construction and operation impacts, 2) include the seagrass and coral that would be permanently impacted by shading, 3) comply with the standard requirements in the COE's Compensatory Mitigation Rule, and 4) identify measures that would be implemented if the seagrass and coral mitigation sites are not trending towards success. Further, we are recommending that Aguirre LLC conduct a detailed geotechnical study of an HDD crossing under the Boca del Infierno pass to substantially reduce impacts on coral reef habitat. If the HDD is determined to be a viable construction method, we are recommending that Aguirre LLC use an HDD to cross the Boca del Infierno pass. However, if Aguirre LLC determines that the HDD construction method is a high risk and not likely to be successful, we are recommending that Aguirre LLC adopt an alternative route that avoids many sensitive coral resources, though it does increase the length of the subsea pipeline.

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[7] In its letters dated October 31, 2013, and September 25, 2014, and additional correspondence, NMFS indicated that alternative measures be implemented to avoid or minimize impacts on federally endangered coral resources, either by a pipeline reroute or alternative installation methods. In its September 2014 letter, NMFS also points to an alternative route analyzed in the draft EIS containing less quality coral habitat than along the proposed route. The COE, EPA, and DNER have provided additional support for implementing alternative installation methods or routes for avoidance of the coral resources in the Boca del Infierno pass.

We also identified noise impacts, both from the subsea pipeline and the Offshore GasPort, to have the potential to disturb marine species. Aguirre LLC has conducted studies on mitigative measures to minimize these impacts, including noise exclusion zones around pile driving activities and the potential use of bubble curtain technology during pile driving activities. We are recommending that prior to construction Aguirre LLC verify that it would use confined bubble curtains when conducting vibratory and hammer pile activities. In addition, we are recommending that Aguirre LLC develop a detailed noise mitigation protocol for the safety exclusion zone (0.3 mile [0.5 km]) that identifies when the noise mitigation protocol would be implemented during construction and explains how each marine mammal observer would identify the limits of the exclusion zone.

To further ensure impacts on marine mammals and sea turtles are minimized during construction and operation of the Project, we have recommended that, prior to construction, Aguirre LLC coordinate with the FWS, NMFS, and DNER to develop a detailed marine mammal observer training and response protocol plan for the construction and operation phases of the Project. In addition, Aguirre LLC should restrict the transit of crew boats during construction and operation to daytime trips to allow for the observation of marine mammals and decrease the potential for vessel strikes.

Several species of birds may be found in the Project area resting or nesting along the shoreline. Due to concerns raised by the DNER, we are recommending that Aguirre LLC provide an assessment of potential noise impacts on resting and nesting birds during the construction and operation of the Project, and identify mitigation measures that could be implemented to minimize or avoid these impacts.

The Project would necessitate the installation of temporary lighting to facilitate construction activities during evening hours as well as for safety requirements. During operations, the FSRU and Offshore GasPort would be lit 24 hours per day by security lighting, navigation lights, and Federal Aviation Administration warning lights. We are recommending that Aguirre LLC develop and file a lighting plan that identifies specific measures that it would implement to minimize or avoid impacts associated with the Project’s operational nighttime lighting on avian species, fish species, marine mammals, and individuals on the shoreline. The plan should also analyze if the Project could artificially induce biological aggregations, and provide empirical evidence of how these potential aggregations could affect local fisheries and tourism.

Threatened and Endangered Species

We have identified 23 federally listed threatened or endangered species and 10 species proposed for Endangered Species Act (ESA) listing occurring or potentially occurring in the Project area. Due to the distance of their primary habitat from the Project area, it was determined that the Project would have no effect on 13 of the listed species and may affect, but is not likely to adversely affect an additional 12 listed or proposed species based on behavioral characteristics; habitat requirements; and the construction, operation, and mitigative measures proposed by Aguirre LLC. We have determined that the remaining eight species would be adversely impacted by the Project; the construction and/or operation of the Project would impact the Antillean manatee and seven species of listed or proposed corals. Our ESA consultation with the FWS and NMFS concerning federally listed species and critical habitats is ongoing.

With mitigation techniques such as the use of trained marine mammal observers and a 0.3-mile (0.5 km) zone of exclusion around vibratory pile driving activities, the temporary impact on manatees including the risk of vessel strikes and stress caused by excessive noise would be greatly reduced. As previously stated, environmental regulatory agencies, including NMFS, have expressed concern over impacts on protected coral species along the subsea pipeline route, specifically in the area of the Boca del Infierno pass. Therefore, we are recommending that Aguirre LLC conduct and file a detailed geotechnical study of an HDD crossing under the Boca del Infierno pass. We are also recommending that Aguirre LLC use an HDD to cross the Boca del Infierno pass if it is determined to be a viable construction method. As previously noted, if the HDD is determined infeasible, we are recommending that Aguirre LLC adopt an alternative pipeline route to the Offshore GasPort.

Operation of the Project would also result in impacts on coral larvae due to loss of individuals entrained in sea water intakes for the FSRU and the LNG carriers while at berth at the Offshore GasPort. During spawning periods, there is potential for entrainment of coral larvae with the highest risk occurring near the intake locations of the FSRU. Based on our entrainment analysis associated with seawater intakes during Project operations, entrainment of coral larvae would likely result in a permanent, moderate impact on coral populations in the region. We reviewed the information submitted by Aguirre LLC, performed our own research, and consulted directly with the agencies regarding federally listed species in the Project area. Aguirre LLC is developing, in discussion with appropriate agencies, a pre-operations coral larvae baseline survey and monitoring plan. The plan would help to further characterize the coral larvae at the proposed Offshore GasPort to understand the potential impacts associated with proposed water use for construction and operation of the Offshore Gasport. Once this additional baseline study has been performed, and prior to implementing Project operations, we are recommending that Aguirre LLC consult with appropriate agencies to develop mitigation measures for the Project impacts on coral larvae and ichthyoplankton. As required by Section 7 of the ESA, we are consulting with the FWS and NMFS to ensure that impacts on ESA-listed species are addressed. Once the final pipeline route is determined (either an HDD under the Boca del Infierno pass or Alternative Route 6), then we will prepare our final Biological Assessment for submittal to the FWS and NMFS. We are recommending that Aguirre LLC not begin construction of the Project until FERC receives comments from the FWS and NMFS regarding the proposed or authorized action; we complete any necessary Section 7 consultation with the FWS and NMFS, if required; and Aguirre LLC has received written notification from the Director of OEP that construction or use of mitigation may begin.

Minor releases of hydrocarbons during construction could result in short-term, minor-to-moderate adverse impacts on protected species. Accidental releases of hydrocarbons resulting from operation of the Project are expected to have short-term and minor-to-moderate impacts on protected species. To ensure that inadvertent hydrocarbon spill impacts on federally listed species and migratory birds are minimized or avoided, we are recommending that prior to construction Aguirre LLC file, as a part of its site-specific spill prevention, control, and countermeasure plan measures that it would implement if wildlife, including federally listed species or migratory birds, are affected by an inadvertent hydrocarbon spill.

Land Use and Recreational Resources

Construction of the Project would alter the land use, recreation, and visual resources of the area by temporarily increasing vessel traffic, thereby impacting recreational boating and fishing. The EIS acknowledges the comments received from residents of Salinas and Guayama that the actual number of recreational and commercial marine uses in and around Jobos Bay is higher than what is reported in public literature searches. In addition, residents also commented that the number of commercial fishermen in and around Jobos Bay is likely higher than reported in the draft EIS because there are many unlicensed fishermen. Operation of the Project would permanently alter the existing visual resources as well as impact boating, fishing, and other marine uses near the Offshore GasPort.

Construction activities would require the use of a variety of vessels including lay barges, dive support vessels, support tugs, crew boats, pipe transport barges, and pipe haul barge tugs, increasing the current levels of large vessel traffic in Jobos Bay, which is typically limited to small recreation and commercial fishing vessels. Our analysis finds that there are abundant areas of fishing in and around Jobos Bay such that construction of the Project would not cause a significant impact on boating and fishing in the area. However, in order to minimize the disruption of access in and around Jobos Bay, we are recommending Aguirre LLC file a Construction Access Plan that clarifies areas that it would restrict to marine users, discusses the duration of any restrictions, and identifies methods of communication of restrictions to the general public. Operation of the Project would have minimal impact on marine use within the bay.

We received comments concerning the potential for the unburied subsea pipeline to become an obstruction to boat traffic in Jobos Bay; however, Aguirre LLC revised its construction method such that the subsea pipeline would be buried up to 3 feet (0.9 m) in some locations in Jobos Bay. Therefore, we find that the pipeline is not anticipated to have a significant impact on the operation of vessels within Jobos Bay. The USCG's proposed safety zone located around the FSRU and LNG carriers would have direct impacts on boating, fishing, and other marine uses in the area, because it would prohibit the transit or use of an area within 500 yards (457 meters) from the facility. The approach of LNG carriers to the Offshore GasPort would be coordinated with the USCG, and the waterway used by the LNG carriers to approach the Offshore GasPort would be broadcast by the USCG. Ultimately the Project would decrease oil barge traffic within Jobos Bay and along the barge channel to the Aguirre Plant due to the plant's conversion to natural gas as a fuel source.

Construction of the Offshore GasPort and subsea pipeline requires a coastal zone consistency review to ensure that the Project is consistent with Coastal Zone Management Program policies. We are recommending that Aguirre LLC not begin construction of the Project until it files with the Secretary a copy of the determination of consistency with the Coastal Zone Management Program issued by the Puerto Rico Planning Board.

The presence of the FSRU and Offshore GasPort would visually affect wildlife viewing from the Cayos Caribes lookout tower and other places within the Jobos Bay National Estuarine Research Reserve that have views of the ocean. The FSRU and Offshore GasPort would be lit 24 hours per day by security lighting, navigation lights, and Federal Aviation Administration warning lights. To minimize impacts associated with nighttime lighting, as previously stated, we are recommending that Aguirre LLC develop a lighting plan to minimize the impacts on individuals on the shore.

Cultural Resources

The area of potential effect for the onshore portion of the Project is within the existing fenced Aguirre Plant property. The Project proposes to disturb approximately 1.5 acres (1.5 cuerdas) of the industrial site during construction for use as a temporary construction staging and support area. The offshore construction would include the construction right-of-way and temporary workspace for the 4.0-mile-long (6.4 km) subsea pipeline and the construction area for the Offshore GasPort. Aguirre LLC conducted archival research and marine surveys of these areas to identify cultural resources including locations for potential prehistoric and historic archaeological sites.

No sites were identified through archival research within the Project area. Aguirre LLC did not conduct an archeological survey within the previously disturbed, terrestrial portion of the Project because of the low potential for intact cultural deposits. In a letter dated August 15, 2012, the State Historic Preservation Office (SHPO) concurred that no archaeological survey is necessary. We concur as well.

The marine area of potential effect included about 155 acres (160 cuerdas) of submerged land that could be affected by the construction and operation of the subsea pipeline and the Offshore GasPort. Aguirre LLC completed evaluative testing in March 2013, prepared a report of findings in April 2013, and submitted a copy to the SHPO for review in June 2013. In a letter dated July 2, 2013, the SHPO concurred that none of the reported anomalies were historically significant and that no further archeological work was required. We concur as well.

Based on the investigations conducted by Aguirre LLC, the comments received from the SHPO, and implementation of Aguirre LLC's unanticipated discoveries plan, we conclude that the Project would not impact any historical resources and that the FERC has met its responsibility under Section 106 of the National Historic Preservation Act.

Air Quality and Noise

Construction of the Project would create emissions from fossil-fueled construction equipment. Such air quality impacts would generally be temporary and localized, and are not expected to cause or contribute to a violation of applicable air quality standards.

Operating the Project, which would include equipment on the FSRU, the Offshore GasPort, and LNG carriers, support vessels, and tugs would create long-term air emissions. Potential impacts of air emissions from Project operations would be reduced by incorporation of operating restrictions and use of emission reduction technologies on the FSRU to limit pollutant emissions. Overall, the Project would reduce emissions at the Aguirre Plant, including almost 800 tons per year (721 metric tons per year) of nitrogen oxides and 5,815 tons per year (5,275 metric tons per year) of sulfur dioxide. In meeting the Project objective of compliance with the EPA Mercury and Air Toxics Standard rule, the local and regional air quality would improve.

Noise would be generated during construction and operation of the Project. Construction of the Offshore GasPort would occur in three phases: the marine infrastructure including berth facilities; topside mechanical and electrical facilities; and the subsea interconnecting pipeline. If an HDD under the Boca del Infierno pass is found to be feasible, additional construction noise would be generated by the HDD equipment. Aguirre LLC proposes to consult with EQB to develop the appropriate mitigation measures should actual sound levels measured during construction activities exceed the nighttime EQB noise limits. In addition to consulting with the EQB for noise impacts on noise sensitive areas (NSA), we are recommending that Aguirre conduct noise modeling to determine the impacts of subsea and ambient noise on wildlife in the area. Further, we recommend that Aguirre LLC consult with the FWS, NMFS, and DNER regarding appropriate mitigation measures to reduce noise levels.

The estimated operational noise of the FSRU would be below existing ambient sound levels at each of the NSAs. We are recommending, however, that Aguirre LLC file a noise survey no later than 60 days after placing the facilities into service to ensure that the noise levels are at or below our criteria of a day-night noise level of 55 decibels on the A-weighted scale (dBA) at the nearest NSAs. If the noise attributable to operation of the Offshore GasPort exceeds a day-night average sound level of 55 dBA at any nearby NSAs, Aguirre LLC would install additional noise controls to meet the level within 1 year of the in-service date. Aguirre LLC would confirm compliance with the requirement by filing a second noise survey no later than 60 days after it installs the additional noise controls.

Safety and Reliability

We evaluated the safety of the proposed Offshore GasPort, the related FSRU operation, LNG carrier transits, and the subsea pipeline. As part of our evaluation of the Offshore GasPort, we performed a technical review of the preliminary engineering design to ensure sufficient layers of protection would be included in the facility designs to mitigate the potential for an incident that could impact the safety of the public. The USCG reviewed the suitability of the waterway along the proposed LNG carrier transit route and determined that the waterway would be suitable for the type and frequency of LNG marine traffic associated with this proposed Project. In addition, Aguirre LLC would be required to comply with all regulations in 33 CFR 105 and 33 CFR 127 for its proposed LNG facilities and 49 CFR 192 for the proposed subsea pipeline. On December 3, 2014, Aguirre LLC filed its modified subsea pipeline design to meet DOT's pipeline safety standards to include burial of the offshore pipeline with the exception of approximately 1,700 feet (518 m) through the area across the Boca del Infierno pass where Aguirre LLC proposes to direct lay the pipeline over the coral reef. The modified construction method meets the requirements of 49 CFR 192. Based on our engineering design analysis and recommendations presented in section 4.11 for the Offshore GasPort, the Letter of Recommendation issued by the USCG for the LNG carrier transit, and the regulatory requirements for the pipeline and the Offshore GasPort, we conclude that the Project would not result in significantly increased public safety risks.

ALTERNATIVES CONSIDERED

As an alternative to the proposed action, we evaluated the No-Action Alternative, system alternatives, facility siting alternatives, Offshore GasPort alternatives, major pipeline route alternatives, and pipeline route variations. While the No-Action Alternative would eliminate the short- and long-term environmental impacts identified in the EIS, the stated objectives of the proposed action would not be met. We also evaluated the use of alternative energy sources and the potential effects of energy conservation, but determined that these sources and measures would not be a practicable alternative to the proposed Project.

One system alternative would be the expansion of the existing EcoEléctrica LNG (EcoEléctrica) facility, which is approximately 35 miles (56 km) east of the Aguirre Plant. For the EcoEléctrica facility to be a viable system alternative to the proposed Project, the facility would have to construct new LNG storage capacity, regasification facilities, and a new pipeline to connect the EcoEléctrica facility to the Aguirre Plant. It should be noted that when originally proposed, EcoEléctrica planned to construct two LNG storage tanks. To date, EcoEléctrica has only constructed one LNG storage tank. For this expansion to be a viable alternative to the proposed action, EcoEléctrica would have needed to start its FERC permitting process in 2012 to obtain approval to construct its tank. As the proposed Project does not require construction of onshore LNG storage or onshore new pipeline, any alternative from EcoEléctrica facility would result in greater environmental impacts than the proposed Project.

A commentor requested that we consider an alternative that would truck the LNG from EcoEléctrica facility to the Aguirre Plant. FERC had recently approved expansion at the EcoEléctrica facility to allow delivery of LNG to a proposed non-jurisdictional LNG truck loading facility (LNG Truck Loading Facility), which is being developed and permitted by Gas Natural Puerto Rico, Inc. Gas Natural Puerto Rico, Inc. is marketing its LNG to end-users in Puerto Rico, such as pharmaceutical, petrochemical, and other industrial facilities. We reviewed the capacity of the facility, the number of trucks required to deliver gas to the Aguirre Plant, and the impacts on the roads and communities with the number of trucks arriving and departing the facility each day and determined that transporting the LNG to the Aguirre Plant by truck was not environmentally preferable to the proposed Project.

Our evaluation of alternative sites also considered construction and operation of two land-based sites and two dockside sites. Two industrial facilities are located on the north shore of Las Mareas Bay: the Chevron-Philips chemical facility and the AES Puerto Rico, L.P. 454-megawatt coal-fired power generation facility. Las Mareas Bay is approximately 6 miles (9.7 km) east of the Aguirre Plant with access to the area off Puerto Rico Highway 3. This industrial area has sufficient land to allow for the development of an onshore LNG facility; however, it would require the construction of a new onshore or dockside terminal at either the Chevron-Philips chemical facility or AES Puerto Rico, L.P. facility, a large dredging and bay development project to accommodate large LNG carriers, and a 6-mile (9.7 km) pipeline to the Aguirre Plant. Impacted areas would mainly consist of previously developed upland but would also include areas of palustrine emergent wetland located along the coastal area. We found that the associated environmental impacts with either a land-based or dockside terminal alternative would be greater than the proposed Project. For these reasons, we conclude that a new land-based or dockside

LNG facility within Las Mareas Bay would not present any significant environmental advantage compared to the proposed Project.

The Aguirre Plant was also considered as an alternative for either a land-based or dockside terminal location. About 30 acres (31 cuerdas) would be required to construct storage tanks, regasification equipment, and other infrastructure to support the facility. In reviewing the area around the Aguirre Plant, 30 contiguous acres (31 cuerdas) are not available that would avoid population centers. In addition, the land-based terminal would require a deepwater access and a turning basin. The lack of available land, the need to create a deepwater access and turning basin, and the proximity to a population center makes a land-based terminal less environmentally preferable than the proposed action. A dockside terminal facility would also require deepwater access and a turning basin large enough for both the FSRU and the LNG carrier as well as modification at the Aguirre Plant to build a pier for the FSRU. The existing jetty at the facility cannot accommodate an FSRU as well as the LNG carrier. Considering its proximity to the Aguirre community, and the extensive amount of in-water work (dredging and pier construction) that would be required, we consider that the environmental impacts of a dockside terminal would be equal or greater than the proposed Project.

We evaluated four alternative Offshore GasPort sites with pipelines to the terminal, and Aguirre LLC conducted field review of each site and corresponding pipeline. All four terminals had similar water depths and seafloor conditions; however, the length of pipeline required and distance to the closest population centers varied. We also analyzed five major terminal/pipeline alternatives in response to concerns from the public and federal and state agencies concerning impacts from the proposed pipeline route through the Boca del Infierno pass on federally threatened and endangered coral species, coral reef habitat, seagrass within Jobos Bay, and the Antillean manatee. Aguirre LLC revised the construction techniques to include pipe burial for its length with the exception of 1,700 feet (518 m) through the Boca del Infierno pass.

Aguirre LLC conducted additional work to determine the feasibility and risk of installing the pipeline through the Boca del Infierno pass using the HDD construction method. Based on a review of the geotechnical subsurface data and the preliminary nearshore geotechnical investigation conducted for the Project, Aguirre LLC determined that a successful HDD of this area would likely be infeasible based on the subsurface geotechnical data currently available. Aguirre LLC's contractor concluded that a detailed subsurface exploration program would be required to determine the feasibility and detailed design of an HDD to cross the Boca del Infierno pass. We are recommending that Aguirre LLC continue to conduct the necessary subsurface investigations to determine the likelihood of a successful HDD. For our comparison of impacts in the EIS, as the success of an HDD is unknown for the Boca del Infierno pass, our analysis assumes a direct lay through coral areas of the proposed route and each of the alternative routes, though we do note where we found impacts would be reduced if the HDD method or an alternative route is adopted by Aguirre LLC.

In our analysis, we do not identify any alternative route that would be environmentally preferable to the proposed route if it is installed through the Boca del Infierno pass using the HDD method to avoid impacts on the coral reef. If, following Aguirre's additional geotechnical work, it is determined that the HDD is not a viable construction method, we are recommending that Aguirre LLC adopt Alternative Route 6 as its proposed route to connect the Offshore GasPort to the Aguirre Plant. While Alternative Route 6 is longer than the proposed route, resulting in a greater area of temporary construction disturbance; it provides an environmentally feasible and practicable alternative to meet the proposed Project objectives while substantially reducing impacts on federally listed coral resources and sensitive benthic habitat.

A pipeline route variation review was completed on four pipeline route variations from the proposed Offshore GasPort to the Aguirre Plant, each passing through Boca del Infierno pass. For each pipeline route variation, the pipeline length, number of bends in the pipeline, and disturbance of submerged aquatic vegetation and coral reef habitat was compared to the corresponding segment of the proposed route. None of the route variations were determined to provide significant environmental advantages over the proposed route and were not evaluated further.

A more detailed comparison of the available vaporization technologies was completed in response to public and agency comments on the draft EIS. None of the alternative vaporization technologies provided significant advantages over the proposed method. In response to a comment, we also analyzed the seawater usage of the FSRU compared to other offshore LNG projects. Our analysis concludes that the additional equipment required for the glycol/water system would be difficult to include on Aguirre LLC's existing ship deck footprint. Further, because the FSRU is a non-FERC-jurisdictional facility, the use of an alternative shell and tube vaporization method that uses the water/glycol closed-loop system is outside of the scope of this EIS.

CONCLUSIONS

We determined that construction and operation of the Project would result in limited adverse environmental impacts that would mostly occur during construction, provided the subsea pipeline does not cross the Boca del Infierno pass via a direct lay. This determination is based on our review of the information provided by Aguirre LLC and further developed from data requests; field investigations; scoping; literature research; alternatives analyses; and contacts with federal, state, and local agencies, and individual members of the public; as well as our recommendations to avoid or reduce certain environmental impacts. We conclude that approval of the Project would have moderate adverse environmental impacts, but these impacts would be reduced to less-than-significant levels if mitigation measures are implemented. Although many factors were considered in this determination, the principal reasons are:

- Aguirre LLC would be required to obtain all necessary federal authorizations prior to beginning construction.
- Aguirre LLC would implement Project-specific construction, restoration, and mitigation plans that would avoid, minimize, or mitigate impacts on natural resources.
- Aguirre LLC would implement our recommended mitigation measures to further reduce the environmental impacts that would otherwise result from construction and operation of the Project.
- The FERC would complete the process of complying with Section 7 of the ESA prior to construction.
- The FERC completed the process of complying with Section 106 of the National Historic Preservation Act.
- An environmental inspection program would be implemented to ensure compliance with the mitigation measures that become conditions of the FERC authorization.

1.0 INTRODUCTION

On April 17, 2013, Aguirre Offshore GasPort, LLC (Aguirre LLC), a wholly owned subsidiary of Excelerate Energy, LP (Excelerate Energy), filed an application with the Federal Energy Regulatory Commission (Commission or FERC) under Section 3 of the Natural Gas Act (NGA) and Part 153 of the Commission's regulations. The application was assigned Docket No. CP13-193-000, and a Notice of Application was issued on April 30, 2013, that was also noticed in the Federal Register on May 6, 2013. Aguirre LLC is seeking authorization from the FERC to develop, construct, and operate a liquefied natural gas (LNG) import terminal off the southern coast of Puerto Rico.

Aguirre LLC's proposal, referred to as the Aguirre Offshore GasPort Project (Project), is being developed in cooperation with the Puerto Rico Electric Power Authority (PREPA) for the purpose of receiving, storing, and regasifying the LNG to be acquired by PREPA; and delivering natural gas to PREPA's existing Aguirre Power Complex (Aguirre Plant) in Salinas, Puerto Rico. The Aguirre Plant is PREPA's largest power facility with an installed generation capacity of 1,492 megawatts (MW), which represents approximately one-third of Puerto Rico's total installed generating capacity. The Project would consist of an Offshore GasPort (berthing platform and FSRU) and 4.0-mile-long (6.4 kilometer [km]), 21-inch (61 centimeters [cm]) outside diameter subsea pipeline connecting the Offshore GasPort to the Aguirre Plant (see figure 1-1). The subsea pipeline would be 18-inch (46 cm) steel pipeline with a 1.5-inch (3.8 cm) concrete coating. The Offshore GasPort would be attended by a Floating Storage and Regasification Unit (FSRU) and ships delivering LNG. Both the FSRU and the LNG carriers would be under the jurisdiction of the U.S. Coast Guard. Aguirre LLC is proposing to place the Project facilities in service in 2016. The proposed Project facilities and schedule are described in detail in section 2.0.

The environmental staff of the FERC prepared this environmental impact statement (EIS) to assess the environmental impacts associated with the construction and operation of the facilities proposed by Aguirre LLC in accordance with the requirements of the National Environmental Policy Act of 1969 (NEPA), as amended. NEPA, and the Council on Environmental Quality's (CEQ) regulations for implementing NEPA in Title 40 Code of Federal Regulations (CFR) Part 1501.6 (40 CFR 1501.6), call on federal, state, and local government agencies to cooperate in the preparation of EISs.

The vertical line in the margin identifies text that is new or modified in the final EIS and differs materially from corresponding text in the draft EIS. Changes were made to address comments from cooperating agencies and other stakeholders on the draft EIS; incorporate modifications to the Project proposed by Aguirre LLC after publication of the draft EIS; and incorporate information filed by Aguirre in response to our recommendations in the draft EIS. As a result of the changes, four of the recommendations identified in the draft EIS are no longer applicable to the Project and do not appear in the final EIS. Additionally, two of our recommendations identified in the draft EIS have been substantively modified in the final EIS, and eight new recommendations have been added in the final EIS.

Proposed Terminal Site

Proposed Subsea Pipeline

1:755,000

0 5 10 Miles

0 7.5 15 Kilometers

N

Figure 1-1
General Location Map
Aguirre Offshore GasPort Project

In accordance with these provisions, the following agencies are participating as cooperating agencies[1] in the preparation of this final EIS:

- U.S. Environmental Protection Agency (EPA);
- U.S. Coast Guard (USCG);
- U.S. Department of Transportation (DOT);
- U.S. Department of Energy (DOE);
- U.S. Department of Agriculture (USDA);
- Puerto Rico Permits Management Office (PMO);
- Puerto Rico Environmental Quality Board (EQB);
- Puerto Rico Planning Board (PRPB);
- Puerto Rico Department of Natural and Environmental Resources (DNER); and
- Puerto Rico Department of Health (PRDH).

The roles of the FERC and the cooperating agencies in the Project review process are described in section 1.2.

1.1 PROJECT PURPOSE AND NEED

According to Aguirre LLC, the purpose of the Project is to provide LNG storage capacity and sustained deliverability of natural gas directly to the Aguirre Plant, which would facilitate PREPA's conversion of the Aguirre Plant from fuel oil only to a dual-fuel generation facility, capable of burning diesel and natural gas for the combined cycle units and fuel oil and natural gas for the thermoelectric plant. The Project would have a storage capacity of 197,400 cubic yards (yd^3) (150,000 cubic meters [m^3]) and sendout capacity of 500 million standard cubic feet per day (MMscf/d) to the Aguirre Plant.

Aguirre LLC's stated benefits of the Project are:

- contributing to the diversification of energy sources, thereby reducing the use of fuel oils, as outlined in PREPA's Corporate Strategic Plan 2011–2015;

- allowing the Aguirre Plant to meet the requirements of the EPA's Mercury and Air Toxics Standard (MATS rule);

- reducing fuel oil barge traffic in Jobos Bay, thereby reducing the potential for fuel spills, reducing potential encounters with certain endangered species, and minimizing impacts on recreational boat traffic; and

- contributing to price stabilization, which is not enjoyed under the current supply scenario.

The Project was developed in response to an Expression of Interest and Pre-Qualification process that was conducted by PREPA in December 2010 to identify a qualified company to develop, permit, finance, construct, and operate an LNG import terminal off the coast of Salinas, Puerto Rico. Excelerate Energy submitted its technical proposal and company qualification to PREPA in January 2011 and was selected by PREPA in February 2011 as the most qualified company to pursue a solution to PREPA's goals.

Under Section 3 of the NGA, the FERC considers, as part of its decision to authorize natural gas facilities, all factors bearing on the public interest. Specifically, regarding whether to authorize natural

[1] A cooperating agency is an agency that has jurisdiction over all or part of a project area and must make a decision on a project, and/or an agency that provides special expertise with regard to environmental or other resources.

gas facilities used for importation or exploration, the FERC shall authorize the proposal unless it finds that the proposed facilities would not be consistent with the public interest.

1.2 PURPOSE AND SCOPE OF THE EIS

Our [2] principal purposes for preparing the EIS are to:

- identify and assess the potential impacts on the natural and human environment that would result from the implementation of the Project;
- describe and evaluate reasonable alternatives to the Project that would avoid or substantially lessen any significant adverse effects of the Project on the environment;
- identify and recommend specific mitigation measures, as necessary, to avoid or minimize significant environmental effects; and
- encourage and facilitate involvement by the public and interested agencies in the environmental review process.

This EIS focuses on the Offshore GasPort and pipeline that are under the FERC's jurisdiction. The topics addressed in this final EIS include geology; soils; water use and quality; wetlands; vegetation; wildlife; fisheries and essential fish habitat (EFH); threatened, endangered, and special status species; land use, recreation, and visual resources; socioeconomics; cultural resources; air quality; noise; reliability and safety; cumulative impacts; and alternatives. This final EIS describes the affected environment as it currently exists, discusses the potential environmental consequences of the proposed Project, and compares the Project's potential impact to that of alternatives. The following sections describe the roles and responsibilities of the FERC and the cooperating agencies.

1.2.1 Federal Energy Regulatory Commission

The FERC is an independent federal agency whose responsibility includes evaluating applications filed for authorization to construct and operate LNG terminals for the importation or exportation of natural gas. The Energy Policy Act of 2005 provides that the FERC shall act as the lead agency for coordinating all applicable authorizations related to jurisdictional natural gas facilities and for purposes of complying with NEPA. As such, the FERC is the lead federal agency for the preparation of the EIS in compliance with the requirements of NEPA, the CEQ regulations for implementing the procedural provisions of NEPA (40 CFR 1500–1508), and the FERC's regulations implementing NEPA (18 CFR 380).

As the lead federal agency for the Project, the FERC is also required to comply with Section 7 of the Endangered Species Act of 1973 (ESA), the Migratory Bird Treaty Act (MBTA), the Bald and Golden Eagle Protection Act, the Magnuson–Stevens Fishery Conservation and Management Act (MSA), the Marine Mammal Protection Act of 1972 (MMPA), Section 106 of the National Historic Preservation Act (NHPA), and Section 307 of the Coastal Zone Management Act of 1972 (CZMA). These and other statutes have been taken into account in the preparation of the EIS.

The Commission will consider the findings of the final EIS as well as non-environmental issues in its review of Aguirre LLC's application to determine whether or not to authorize the proposed Project. An authorization will be granted only if the FERC finds that the evidence produced on financing, rates, market demand, gas supply, existing facilities and service, environmental impacts, long-term feasibility, and other issues demonstrates that the Project is consistent with the public interest. Environmental impact assessment and mitigation development are important factors in the overall public interest determination.

[2] "We," "us," and "our" refer to the environmental staff of the FERC's Office of Energy Projects.

This effort was undertaken with the participation and assistance of the EPA, USCG, DOT, DOE, USDA, PMO, EQB, PRPB, DNER, and PRDH as "cooperating agencies" under NEPA. Cooperating agencies have jurisdiction by law or special expertise with respect to environmental impacts involved with a proposal. Permitting and consulting agencies such as the U.S. Army Corps of Engineers (COE), U.S. Fish and Wildlife Service (FWS), and National Marine Fisheries Service (NMFS) provided assistance in preparing this EIS. The roles of the cooperating federal and commonwealth agencies in the Project review process are described below. The EIS provides a basis for coordinated federal decision-making in a single document, avoiding duplication among federal agencies in the NEPA environmental review processes. In addition to the lead and cooperating agencies, other federal, state, and local agencies may use this EIS in approving or issuing permits for all or part of the proposed Project. Federal, state, and local permits, approvals, and consultations for the Project are discussed in section 1.5.

1.2.2 U.S. Environmental Protection Agency – Region 2

The EPA is an independent federal agency responsible for protecting human health and safeguarding the natural environment. It sets and enforces national standards under a variety of environmental laws and regulations in consultation with state, tribal, and local governments. The EPA has delegated water quality certification (Section 401 of the Clean Water Act [CWA]) to the jurisdiction of individual state agencies, but the EPA may assume this authority if no state program exists, if the state program is not functioning adequately, or at the request of a state. The National Pollutant Discharge Elimination System (NPDES) program is not delegated to the Commonwealth of Puerto Rico. The EPA implements the NPDES program and issues NPDES permits to dischargers. In addition, the EPA has authority to review and veto permits issued by the COE under Section 404 of the CWA.

The EPA has jurisdictional authority to control air pollution under the Clean Air Act (CAA) (42 United States Code [USC] Chapter 85 [42 USC 85]) by developing and enforcing rules and regulations for all entities that emit air pollutants into the air. Under this authority, the EPA has developed regulations for major sources of air pollution and has delegated the authority to implement these regulations to state and local agencies. State and local agencies are allowed to develop and implement their own regulations for non-major sources of air pollutants. The EPA also establishes general conformity applicability thresholds that a federal agency can utilize to determine whether a specific action requires a general conformity assessment. The EPA has jurisdictional authority in Puerto Rico in the case of the federal Prevention of Significant Deterioration of Air Quality (PSD) regulations codified in 40 CFR 52.21.

In addition to its permitting responsibilities, the EPA is required under Section 309 of the CAA to review and publicly comment on the environmental impacts of major federal actions including actions that are the subject of draft and final EISs, and is responsible for implementing certain procedural provisions of NEPA (e.g., publishing the Notices of Availability of the draft and final EISs in the Federal Register) to establish statutory timeframes for the environmental review process.

1.2.3 U.S. Coast Guard – Sector San Juan

The USCG is the federal agency within the U.S. Department of Homeland Security responsible for assessing the suitability of the Project Waterway (defined as the waterways that begin at the outer boundary of the navigable waters of the United States and extend to the FSRU) for LNG carrier traffic to and from the Offshore GasPort. The USCG exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under Executive Order 10173; the MSA (50 USC 191); the Ports and Waterways Safety Act of 1972, as amended (33 USC 1221 et seq.); and the Maritime Transportation Security Act of 2002 (46 USC 701). The USCG is responsible for matters related to navigation safety, vessel engineering and safety standards, and all matters pertaining to the safety of facilities or equipment located in or adjacent to navigable waters up to the last valve immediately before the receiving tanks. As appropriate, the USCG (acting under the authority in 33 USC 1221 et seq.) also will inform the FERC of design- and construction-related issues identified as part of safety and security assessments. If the Project is approved, constructed, and operated, the USCG would continue to exercise regulatory oversight of the safety and security of this facility, in compliance with 33 CFR 127.

On May 2, 2014, the USCG Captain of the Port (COTP), Sector San Juan, issued a Letter of Recommendation (LOR) regarding the suitability of the Project Waterway for LNG carrier traffic to and from the proposed FSRU. The LOR determination was based on the LOR Analysis (see appendix B), which included a detailed review of the final Waterway Suitability Assessment (WSA) and outlined the USCG's assessment of potential navigation safety and maritime security risks and identified strategies for managing potential risks. The LOR recommended that the waterway surrounding Jobos Bay be considered suitable for accommodating the type and frequency of LNG marine traffic associated with this Project. The COTP made this determination following his review of the factors listed in 33 CFR 127.007 and 33 CFR 127.009.

As part of the LOR analysis, the USCG identified the need for a safety zone around the offshore terminal and the LNG carriers. The safety zone is intended to protect what is outside of the zone from what is inside the zone. As proposed by the USCG, it will establish a moving 100-yard (91 meter [m]) safety zone for all LNG carriers entering the surrounding areas of Jobos Bay while on approach and departure to the Offshore GasPort. The Aguirre Offshore GasPort will have a fixed 500-yard (457-m) safety zone at all times encompassing an area of about 303.3 acres (312.3 cuerdas). Once the LNG carrier is moored, it will be part of the 500-yard (457-m) safety zone regulation. Vessels not related to the operation of the terminal would not be permitted to enter this area or within the water column or seafloor beneath the safety zone without proper authorization from the COTP Sector San Juan. All unauthorized vessels (i.e., fishing boats, sailboats, pleasure crafts, and any other watercraft or marine vessel) would be prohibited from anchoring or transiting the 500-yard (457-m) safety zone at any time.

If the FERC approves the LNG facility, Aguirre LLC subsequently would be required to submit plans or procedures for USCG approval in accordance with 33 CFR 127.017. The USCG also would initiate rulemaking procedures to establish the safety zone around the Offshore GasPort and LNG carriers. Some of these actions and their impacts are described in this EIS. Others are considered Sensitive Security Information and are not releasable to the public (in accordance with 49 CFR 1520). These future actions would be subject to additional environmental review in accordance with the USCG's *National Environmental Policy Act Implementing Procedures and Policy for Considering Environmental Impacts*, as described in the USCG Commandant Instruction Manual.

1.2.4 U.S. Department of Transportation

The DOT administers the national regulatory program to ensure the safe transportation of natural gas, petroleum, and other hazardous materials by pipeline under Title 49 USC Chapter 601. The DOT's Pipeline and Hazardous Materials Safety Administration (PHMSA) Office of Pipeline Safety is responsible for establishing and enforcing standards for the safe and environmentally sound transportation of hazardous materials including the transportation of natural gas and hazardous liquids by pipeline. These standards encompass the design, installation, inspection, emergency plans and procedures, testing, construction, extension, operation, replacement, and maintenance of facilities used in the transportation of natural gas and hazardous liquids by pipeline. PHMSA is not authorized to designate the route of a proposed pipeline.

The DOT is responsible for ensuring that Aguirre LLC's facilities are designed, constructed, and operated in compliance with the safety standards that the agency has established for natural gas pipeline facilities. As previously noted, PHMSA is working with Aguirre LLC to ensure that its proposed construction methods meet the requirements of 49 CFR 192.327(f).

1.2.5 U.S. Department of Energy

The DOE is a Cabinet-level Department of the federal government. The DOE's mission is to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions. The DOE's Loan Programs Office administers DOE's Loan Programs enacted under Title XVII of the Energy Policy Act of 2005, as amended (42 USC sections 16,511–16,516). Title XVII established a federal loan guarantee program for certain energy projects that employ innovative technologies, and authorizes the Secretary of Energy to make loan guarantees for a variety of projects. Specifically, Title XVII identifies the projects as those that avoid, reduce, or sequester anthropogenic emissions of greenhouse gases, and employ new or significantly improved technologies as compared to commercial technologies in service in the United States at the time the guarantee is issued.

On December 12, 2013, the DOE issued a federal loan guarantee program solicitation under Title XVII entitled "Federal Loan Guarantees for Advanced Fossil Energy Projects" (Solicitation No. DE-SOL-0006303). In response to the Solicitation, PREPA submitted an application for the proposed Aguirre Project. PREPA applied for a loan guarantee for the construction of the Aguirre Offshore GasPort Project (including the non-jurisdictional facilities described in section 1.4) a subsea pipeline connecting the Offshore GasPort to the Aguirre Plant, and conversion of multiple electricity-generating units and other modifications at the Aguirre Plant (see section 1.4.1).

The DOE's action is to consider whether or not to issue a federal loan guarantee to PREPA. The purpose and need for the DOE loan guarantee action is to comply with the DOE mandate under Title XVII of the Energy Policy Act of 2005 by selecting projects that are consistent with program goals. The two principal goals of the loan guarantee program are to encourage commercial use in the United States of new or significantly improved energy-related technologies and to achieve substantial environmental benefits. The DOE is a cooperating agency for the preparation of this EIS to comply with its NEPA and related environmental and cultural resource regulatory compliance responsibilities.

1.2.6 U.S. Department of Agriculture, Rural Utilities Service

Under the authority of the Rural Electrification Act of 1936, the Electric Programs of the Rural Utilities Service (RUS), an agency of the USDA, is authorized to make loans and loan guarantees to finance the construction of electric distribution, transmission, and generation facilities, including system improvements and replacements required to furnish and improve electric service in rural areas, as well as demand side management, energy conservation programs, and on-grid and off-grid renewable energy systems. PREPA, a current RUS borrower, may request long-term financing assistance from RUS in association with the proposed Project. RUS may consider approving this request. Because RUS considers the approval of financial assistance a federal action subject to the agency's *Environmental Policies and Procedures* (i.e., its NEPA implementing regulations in 7 CFR 1794), it has elected to participate as a cooperating agency in the preparation of this EIS. The RUS would adopt the EIS in compliance with 40 CFR 1506.3 and 7 CFR 1974.72 if, after an independent review of the document, it concludes that the EIS satisfies the agency's environmental policies and procedures.

1.2.7 Other Federal Permitting and Consulting Agencies

1.2.7.1 U.S. Army Corps of Engineers – Jacksonville District

The COE is a federal agency within the U.S. Department of Defense responsible for regulating the discharge of dredged or fill material into waters of the United States under Section 404 of the CWA

(33 USC 1344), and works or construction of any structure affecting navigable waters of the United States under Section 10 of the Rivers and Harbors Act (33 USC 403). The COE is also responsible for regulating the transportation of dredged material to be discharged into the ocean under Section 103 of the Marine Protection Research and Sanctuaries Act of 1972 and regulating moorings, buoys, and markers that are maintained by private individual or organizations under 33 CFR 66, Private Aids to Navigation.

Aguirre LLC filed its application with the Jacksonville District of the COE on July 9, 2013, and provided additional information in August and September 2013 in response to comments from the COE. The COE issued a public notice for Aguirre LLC's application on October 1, 2013, which opened a 30-day comment period. The COE issued a second public notice on August 15, 2014 to announce the release and availability of the draft EIS prepared by FERC. On October 31, 2014, the COE issued a letter to Aguirre LLC noting concerns about the proposed Project and potential alternatives. In particular, the COE encouraged an assessment of the horizontal directional drill (HDD) method to avoid the coral areas.

In a letter dated January 28, 2015, the COE informed the FERC staff that it was retracting its participation as a cooperating agency and withdrawing from the FERC's NEPA process for the Project. The COE's stated reason was that it could not support an EIS that would result in a FERC authorization that contained conditions for certain pending environmental issues. The COE also stated that it could not accept the FERC's defined range of alternatives and that additional alternatives should have been considered as part of the NEPA analysis. [3]

1.2.7.2 National Marine Fisheries Service

NMFS is a federal agency within the U.S. Department of Commerce responsible for stewardship of the nation's living marine resources and their habitat. NMFS is charged with the management, conservation, and protection of living marine resources within the United States' Exclusive Economic Zone, which extends from 3 to 200 miles offshore. The Aguirre Offshore GasPort Project would affect living marine resources and habitat (marine mammals, threatened and endangered species, and essential fish habitat (EFH)), which are managed by NMFS under the MMPA, ESA, and MSA.

Both Aguirre LLC and FERC staff are consulting with NMFS to assess impacts on living marine resources. NMFS may adopt this final EIS if it concludes that the document satisfies its requirements relative to its mandates under the MMPA. As an element of its review, NMFS will evaluate potential impacts to marine mammals and the proposed mitigation and monitoring measures for reducing those impacts.

1.2.7.3 U.S. Fish and Wildlife Service

The FWS is responsible for ensuring compliance with the ESA. Section 7 of the ESA, as amended, states that any project authorized, funded, or conducted by any federal agencies should not "…jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined…to be critical…" (16 USC 1536(a)(2)). The FWS also reviews project plans and provides comments regarding protection of fish and wildlife resources under the provisions of the Fish and Wildlife Coordination Act (16 USC 661 et seq.). The FWS is responsible for the implementation of the provisions of the Migratory Bird Treaty Act (MBTA) (16 USC 703) and the Bald and Golden Eagle Protection Act (BGEPA) (16 USC 688).

Section 7 of the ESA requires identification of and consultation on aspects of any federal action that may have effects on federally listed species, species proposed for federal listing, and their habitat.

[3] The COE, if it later chooses to do so, could decide to adopt the FERC EIS in accordance with CEQ's regulations at 40 CFR 1506.2.

The ultimate responsibility for compliance with Section 7 remains with the lead federal agency (i.e., the FERC for this project).

As the lead federal agency for the project, the FERC will consult with the FWS pursuant to Section 7 of the ESA to determine whether federally listed endangered or threatened species or designated critical habitat are found in the vicinity of the project, and to evaluate the proposed action's potential effects on those species or critical habitats. The FERC will also coordinate with the FWS regarding other federal trust wildlife resources, such as migratory birds. The FWS elected to consult with us in preparing this EIS because it has special expertise with respect to environmental impacts associated with the project.

1.2.8 Commonwealth of Puerto Rico Agencies

1.2.8.1 Puerto Rico Permits Management Office

The PMO was created under the Puerto Rico Permits Process Reform Act (Act No. 161; December 2009) and is responsible for issuing final determinations and permits, licenses, inspections, certifications, and any other government documents through interagency agreements required for the purposes of construction, land use, and conducting or operating businesses in Puerto Rico. The PMO participates in the environmental planning process by evaluating environmental documents, and through investigation and analysis of proposed activities and impacts. This includes obtaining comments and recommendations from other agencies with expertise, jurisdiction, and interest in a matter as well as from the community when necessary.

In regards to the proposed Project, the PMO held joint hearings with the FERC to solicit public comments regarding the EIS for the Project. After careful evaluation, the PMO will issue an Environmental Compliance Determination and a Final Resolution for the Project.

1.2.8.2 Puerto Rico Environmental Quality Board

The EQB was created under the Puerto Rico Environmental Public Policy Act (Act No. 416; September 2004) and is responsible for protecting environmental quality by exercising control over the air, water, and soil pollution, as well as noise pollution, and using all practical means and measures to create and maintain conditions under which man and nature are able to coexist in productive harmony and to meet the needs that may arise for the present and the future generations of Puerto Ricans.

In regards to the proposed Project, the EQB will provide its conclusions regarding potential impacts on air quality and water resources to the PMO to include in its determination and facilitate the issuance of the necessary permits.

1.2.8.3 Puerto Rico Planning Board

The PRPB was created under the Puerto Rico Planning Board Organic Act (Act No. 75; June 1975) and is responsible for guiding the development of Puerto Rico in a manner which, according to the present and future social needs and human environmental, physical, and economic resources, will best promote the health, safety, order, coexistence, prosperity, defense, culture, economic stability, and general welfare of the present and future inhabitants.

In regards to the proposed Project, the PRPB is the state agency responsible for the review and issuance of the Federal Consistency Certificate with the CZMP. The PRPB will provide its conclusions regarding federal consistency of the required federal permits with the CZMP enforceable policies to the PMO to include in its determination. The PRPB will also provide the required analysis and recommendations about other potential land use impacts and facilitate the issuance of required state permits.

1.2.8.4 Puerto Rico Department of Natural and Environmental Resources

The DNER was created under the Organic Act of the Department of Natural and Environmental Resources (Act No. 23; June 1972) and is responsible for protecting, conserving, and managing Puerto Rico's natural and environmental resources in a balanced way to guarantee their enjoyment by future generations and promote a better quality of life.

In regards to the proposed Project, the DNER will provide its conclusions regarding potential impacts on water resources, wildlife, and submerged lands to the PMO to include in its determination and facilitate the issuance of the necessary permits.

1.2.8.5 Puerto Rico Department of Health

The PRDH was created under the Health Department Law (Act. No. 81; March 2012). The PRDH is responsible for regulating and overseeing all matters provided by law related to public health, sanitation, and welfare, except those related to maritime quarantine services.

In regards to the proposed Project, the PRDH does not have a permit that would apply; the Sanitary License for the Aguirre Plant would be modified to include the added facilities.

1.3 PUBLIC REVIEW AND COMMENT

On December 21, 2011, Aguirre LLC filed a request with the FERC to implement the Commission's pre-filing process for the Project. At that time, Aguirre LLC was in the preliminary design stage of the Project and no formal application had been filed with the FERC. The purpose of the pre-filing process is to encourage the early involvement of interested stakeholders, facilitate interagency cooperation, and identify and resolve issues before an application is filed with the FERC. On January 1, 2012, the FERC granted Aguirre LLC's request and established a pre-filing docket number (PF12-4-000) to place information related to the Project into the public record.

Aguirre LLC held three informational open houses in February 2012, September 2012, and May 2013. The purpose of the open houses was to provide affected landowners, elected and agency officials, and the general public with information about the Project and to give them an opportunity to ask questions and express their concerns. We participated in the open houses and provided information regarding the Commission's environmental review process to interested stakeholders and to take comments about the Project and the alternatives. The substantive questions and concerns raised by the public at the open houses are addressed in the EIS.

On February 28, 2012, the Commission issued a *Notice of Intent to Prepare an Environmental Impact Statement for the Planned Aguirre Offshore GasPort Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meetings*. The notice was published in the Federal Register on March 5, 2012, and mailed to more than 130 interested parties, including federal, state, and local government representatives and agencies; elected officials; environmental and public interest groups; other interested parties; and local libraries and newspapers. The notice briefly described the Project and the EIS process, provided a preliminary list of environmental issues identified by us, invited written comments on the environmental issues that should be addressed in the draft EIS, listed the date and location of two public scoping meetings to be held in the Project area, and established a closing date for receipt of comments of March 30, 2012. In addition to comments received from the cooperating agencies, we received approximately 25 comment letters from various stakeholders, including the U.S. Fish and Wildlife Service (FWS); National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS); U.S. National Park Service; Governor of the Commonwealth of Puerto Rico; PREPA; Puerto Rico Federal Affairs Administration; Puerto Rico Pilotage Commission;

Government Development Bank of Puerto Rico; Comité Diálogo Ambiental; Center for Biological Diversity; and Captain Jimmy Vazquez-Aran.

Our public scoping meetings provided an opportunity for agencies, stakeholders, and the general public to learn more about the proposed Project and participate in the environmental analysis by commenting on the issues to be addressed in the draft EIS. The first meeting was in the Town of Guayama on March 20, 2012; the second meeting was in the Town of Salinas on March 21, 2012. Approximately 30 people attended the meeting in Guayama and 45 people attended the meeting in Salinas. Each meeting was recorded, and the transcripts were placed into the public record for the Project. We received 16 verbal comments from the public scoping meetings.

FERC coordinated several interagency scoping meetings in the Project area to solicit comments about the Project from other permitting and resource agencies. The date, location, and attendees for these meetings are summarized in table 1.3-1. We conducted a field visit with Aguirre LLC on February 2, 2012 to review the proposed locations of the onshore and offshore facilities. We also attended the USCG's public hearing for the Aguirre Offshore GasPort Safety Zone Regulation on June 20, 2014.

TABLE 1.3-1

Interagency Scoping Meetings for the Aguirre Offshore GasPort Project

Date	Agencies in Attendance	Location
March 19, 2012	USCG	USCG Office, San Juan
March 20, 2012	EPA; COE; USCG; FWS; EQB; PRPB; and Governor of Puerto Rico's Office	EPA Office, Guaynabo
May 10, 2012	EPA	EPA Office, New York, NY
September 20, 2012	FWS; NMFS	FWS Office, Boqueron
May 8, 2013	EQB	EQB Office, San Juan
May 9, 2013	FWS	FWS Office, Boqueron
May 10, 2013	PRPB	PRPB Office, Hato Rey
November 6, 2013	EPA; COE; USCG; FWS; NMFS, EQB; PRPB; PMO; DNER; PRDH; and State Historic Preservation Office	COE Office, San Juan
June 19, 2014	PMO	PMO Office, San Juan

The transcripts of the public scoping meetings, summaries of the interagency scoping meetings, and all written scoping comments are part of the public record for the Project and are available for viewing on the FERC internet website (http://www.ferc.gov)[4]. On September 5, 2012; February 18, 2013; April 15, 2013; and December 4, 2013, we issued Project Updates, which outlined the status of the environmental review process and included a summary of the issues identified through the scoping process.

Table 1.3-2 lists the environmental issues that were identified during scoping and indicates the section of the final EIS where each issue is addressed. Additional issues we independently identified are also discussed in the final EIS.

[4] Using the "eLibrary" link, select "General Search" from the eLibrary menu, enter the desired date range and Docket Number (i.e., CP13-193 or PF12-4), and follow the instructions.

TABLE 1.3-2 **Issues and Concerns Identified During the Scoping Process for the Aguirre Offshore GasPort Project**	
Issue/Concern	EIS Section Addressing the Comment
Project need	1.1
Natural gas capacity on the FSRU	2.8
Alternative sites and alternative construction techniques	3.0
Water use and quality	4.3
Threatened and endangered species and habitat, including coral resources	4.6
Commercial and recreational fishing and boating	4.7 and 4.8
Marine navigation and traffic	4.7 and 4.11
Social and economic concerns	4.8
Air quality and emissions	4.10.1
Noise from construction and operation	4.10.2
Safety	4.11

On August 7, 2014, we issued a *Notice of Availability of the Draft Environmental Impact Statement for the Proposed Aguirre Offshore GasPort Project,* which listed the dates, times, and locations for meetings to listen to public comments on the draft EIS. The notice was published in the Federal Register, mailed to stakeholders on the Project, and advertised in three local newspapers. The draft EIS was published in English and Spanish and all notices were provided in both languages. In addition, color flyers announcing the meetings were placed in venues (post office, marina, grocery stores, etc.) to ensure the general public was aware of the meetings. The first meeting was held in Guayama on September 9, 2014, and the second meeting was held in Salinas on September 10, 2014. These meetings were held jointly with the PMO and were conducted in English and Spanish using a live translation service. Sixteen speakers gave comments at the comment meetings.

The comment period for receiving written comments on the draft EIS closed on September 29, 2014. We received 27 written comment letters that included over 300 individual comments. Written comments were received from federal, state, and local agencies; companies/organizations; individuals; and Aguirre LLC. The transcripts from the public comment meetings and the written comment letters are available for viewing on the FERC's website (http://www.ferc.gov). All substantive comments related to environmental issues received on the draft EIS, including those comments submitted outside of the comment period but within a timeframe that allowed for their review, are addressed in Volume I and summarized in the FERC staff's responses in Volume II of the EIS. Substantive changes in the final EIS are indicated by vertical bars that appear in the margins. These changes were made both in response to substantive comments received on the draft EIS and as a result of updated information that became available after the issuance of the draft EIS.

Most of the commentors expressed opposition to the Project, citing safety concerns, a preference for renewable energy solutions, and the impact on commercial fishing and recreational opportunities. Other concerns were similar to those identified during the scoping process and included whether the Project is needed; preferences for alternative pipeline routes that avoided coral, seagrasses, and recreational areas; concerns about the EIS process; and potential impacts on low income and minority communities, municipal infrastructure, and the environment. Those in favor of the Project pointed out the need for new sources of energy and the environmental (e.g., cleaner air) and economic benefits that the Project would bring.

We received a comment letter from PHMSA on October 31, 2014, explaining that the proposed construction method of the pipeline, as described in the draft EIS, "did not show any burial cover, which does not meet 49 CFR 192.327(f) which requires burial below natural grade sea bottom or an alternative equivalent protection system." Therefore, Aguirre LLC would need to request a waiver from the DOT regulations or bury the pipeline according to the regulations in 49 CFR 192. Following several meetings with PHMSA and FERC, Aguirre LLC modified its proposed construction methods to include burial of the offshore pipeline to below natural bottom with the exception of approximately 1,700 feet (518 m) through the area across the Boca del Infierno pass where Aguirre LLC proposes to direct lay over the coral reef with concrete mats placed over the pipeline. The modified construction method required revisions to this environmental analysis of the Project's impact.

In addition, in a letter dated September 29, 2014, Aguirre LLC noted that, following input from the Aguirre community, the point where the offshore pipeline came ashore was shifted 200 feet (61 m) to the south end of the bulkhead. This change, which is reflected in this final EIS, reduced the length of offshore pipeline from 4.1 to 4.0 miles (6.6 km to 6.4 km).

Copies of this final EIS have been mailed to the agencies, individuals, organizations, and other parties identified in the distribution list provided as appendix A. This EIS has been translated into Spanish to facilitate public review. Additionally, the final EIS has been filed with the EPA for issuance of a formal Notice of Availability in the Federal Register. In accordance with the CEQ's regulations implementing NEPA, no agency decision on the proposed actions may be made until 30 days after the EPA publishes the Notice of Availability in the Federal Register. However, the CEQ regulations provide an exception to this rule when an agency decision is subject to a formal internal appeal process that allows other agencies or the public to make their views known. This is the case at the FERC, where any Commission decision on the proposed action would be subject to a 30-day rehearing period. Therefore, the FERC decision may be made and recorded concurrently with the publication of the final EIS or any time thereafter.

1.4 NON-JURISDICTIONAL FACILITIES

FERC is required to consider, as part of a decision to authorize jurisdictional facilities, all facilities that are directly related to a proposed project where there is sufficient federal control and responsibility to warrant environmental analysis as part of the NEPA environmental review for the proposed Project. Some proposed projects have associated facilities that do not come under the jurisdiction of the Commission. These "non-jurisdictional" facilities may be integral to the need for the proposed facilities, or they may be merely associated as minor components of the jurisdictional facilities that would be constructed and operated as a result of authorization of the proposed facilities.

Two non-jurisdictional actions were identified in association with the proposed Project: new piping and associated facilities including the conversion of the steam power plant and the combined cycle power plant, all within the Aguirre Plant; and the FSRU at the proposed Offshore GasPort. These facilities are addressed below and are also addressed in our cumulative impacts analysis in section 4.12 of this EIS.

1.4.1 Aguirre Power Complex

The Aguirre Plant is PREPA's largest power facility with an installed generation capacity of approximately 1,492 MW. PREPA developed the Aguirre Plant from 1972 to 1977 to generate electricity using No. 2 oil and No. 6 oil with twelve fuel combustion sources located in three plant areas, including a combined cycle power plant, a steam power plant, and a simple cycle power block. In response to the new EPA MATS rule, and in response to the Puerto Rico Government's policy to promote the use of natural gas to lower energy cost and reduce Puerto Rico's carbon footprint, PREPA is planning to provide the capability to burn natural gas in both the two-unit, 900-MW steam power plant (AG 1 and 2) and the two-unit, 600-MW combined cycle power plant (CC 1 and 2) at the Aguirre Plant. The two-unit steam plant consists of two boilers and two steam generators, and the two-unit combined cycle power plant consists of eight combustion turbines and two steam generators. The schedule for the modifications to the steam power plant would coincide with the completion of the proposed Project.

PREPA would construct piping and associated facilities within the Aguirre Plant property, beyond the flange at the end of Aguirre LLC's subsea pipeline and as required to complete the connection to the combined cycle plant and the thermoelectric plant power station. These facilities would include a metering station, pressure reduction equipment, process gas heat exchangers, and interconnecting pipework. The onshore pipeline would have a diameter of 18 inches (45 cm) and would extend approximately 985 feet (300 m) from the Project's onshore pipeline terminus/pig trap to the gas delivery point located on the northeast area of the facility. The onshore pipeline would be placed on stanchions located to the south of the existing fuel and water tanks at the plant. The metering station and associated equipment at the gas delivery point would be installed in an area that has been previously disturbed and is currently used to support the Aguirre Plant operations.

All of the activities associated with conversion of the Aguirre Plant would occur within the fence line of the existing power plant. No additional land would be acquired to complete this action. Access to the power plant would be via state road PR-7710, which is accessed from state road PR-3. There would be little to no associated impact on vegetation within the fence line as the affected area has been subject to heavy industrial activities for nearly 40 years. The area of disturbance would include approximately 0.7 acre (0.7 cuerda) for the meter station and other equipment and 0.4 acre (0.4 cuerda) for the 2-foot-wide (0.6 m) corridor along the pipeline. Additional piping would be installed to connect to the steam power plant and the combined cycle power plant.

Construction within the power plant would not affect any waterbodies; the nearest waterbody is the Caribbean Sea. National Wetlands Inventory (NWI) mapping identifies portions of the plant as wetlands; however, all of those areas have been previously filled and developed for industrial use. Onshore construction activities would not occur in any Special Flood Hazard Areas (100-year flood, Zone AE), as shown on the Federal Emergency Management Agency (FEMA), Flood Insurance Rate Map (FEMA, 2009). PREPA would use its on-site water sources for hydrostatic testing of the pipeline. Discharge would occur through the power plant's water treatment plant. Adequate sanitary services are available at the power plant and connected to the Puerto Rico Aqueduct and Sewer Authority. No potable water wells are within a radius of 1,510 feet (460 m) to the conversion activities, and the area is not located in a classified flood prone zone.

The conversion activities would generate about 3 tons (910 kilograms [kg]) of recyclable material (e.g., scrap metal) and about 3 yd^3 (2.3 m^3) of common waste (e.g., cardboard, wood, cable, etc.). The common waste would be stored in the power plant's waste bins and would be disposed of with the power plant's common waste. Similarly, the recyclable material would be stored in the recycling container for metals and would be eventually sold to an authorized facility.

According to the proposed Territorial Zoning Plan for the Municipality of Salina, the conversion project qualifies as 100 percent rustic land specially protected; however, the conversion activities would not have an impact on the power plant's surroundings. In addition, there are no known cultural resources within the construction area, demonstrated in a Phase 1A and 1B August 2012 study conducted for a previous project in the power plant. However, if any archeological or cultural resources are found during construction, PREPA would stop work and immediately notify the Institute of Puerto Rican Culture.

The nearest tranquility zone (as defined by PREPA) is about 1,390 feet (425 m) to the Project while the nearest home is about 750 feet (229 m) away. PREPA estimates that conversion of the plant would not cause noise to increase above the current noise levels. The noise level during operation of the subsea pipeline is estimated to be 51 decibels (dB) on the A-weighted scale (dBA) or less at the closest community noise-sensitive area (NSA) in relation to the pipeline lateral. To reduce the operational noise level of the pipeline, PREPA will use the Emerson Fisher Whisper Trim and the Downstream Whisper Disk as necessary to ensure a quieted design. These noise attenuation devices are anticipated to reduce the noise generated by turbulent gas flow noise and associated vibration across control valves and pressure gauges. No noise control measures are currently planned to be used during construction; however, if exceedances of the limits are identified, PREPA would obtain a special variance from the EQB. PREPA's construction contractor would adhere to all requirements of the ordinance and obtain special variances, if necessary.

The operational air emissions at the Aguirre Plant would be reduced as a result of the conversion from oil to natural gas as the combustion source. Further details regarding the cumulative air quality impacts of the Aguirre Plant and the proposed Project are discussed in section 4.12, Cumulative Impacts.

PREPA submitted the necessary permits for the fuel conversion to the EQB in July and August 2013 and plans to complete the equipment modifications by third quarter of 2015. Aguirre LLC assisted PREPA in preparation of a Non-Jurisdictional Facility Environmental Report for the conversion activities.[5]

1.4.2 Floating Storage and Regasification Unit

Aguirre LLC would utilize one of Excelerate Energy's existing Energy Bridge Regasification Vessels (EBRV) as the FSRU for the Project. EBRVs are purpose-built LNG tankers capable of ocean travel that incorporate onboard equipment for the vaporization of LNG and delivery of high-pressure natural gas. EBRVs utilize a steam-generating plant in the vessel for propulsion and overall vessel operations. These vessels were developed jointly by Excelerate Energy, Exmar NV, and Daewoo Shipbuilding & Marine Engineering Co., Ltd. Excelerate Energy currently has nine EBRVs in its fleet, all of which are classified under survey of Bureau Veritas classification society, and a ninth is under construction for a project in South America. Construction of a new FSRU for this Project would not be required. The EBRV placed into service for the proposed Project would have a storage capacity of up to 197,400 yd^3 (150,900 m^3) of LNG, an overall length of 955 feet (291 m), and a design draft of 38 feet (11.6 m).

The FSRU would be moored to the north side of the Offshore GasPort to perform regasification operations. Periodic maintenance of the FSRU must be performed, however, in order to keep vessel class certificates and ensure commercial reliability. Additionally, scheduled dry-docking would be performed as per class requirements, which is typically done once every 5 years. A normal dry-dock period is about 21 days, excluding transit time to and from the respective dry-dock port. Excelerate Energy would use reasonable efforts to provide a similar FSRU during dry-dock periods.

The FSRU for the Project would be subject to and would comply with USCG 46 CFR, Chapter I, Subchapter O Endorsement and Port State Inspections for a foreign flag vessel operating in U.S. waters. The vessels delivering LNG to the Offshore GasPort would be conventional LNG carriers that could include vessels owned and operated by Excelerate Energy or by other third-party LNG carrier owners/operators. These LNG carriers would also comply with applicable Class, USCG, and Port State requirements.

[5] Provided as part of the public record for Docket No. CP13-193-000 on the FERC website at http://ferc.gov/docs-filing/elibrary.asp; Accession No. 20140220-5214.

1.5 PERMITS, APPROVALS, CONSULTATIONS, AND REGULATORY REQUIREMENTS

As a federal agency, the FERC is required to comply with a number of regulatory statutes including, but not limited to NEPA, Section 7 of the ESA, CAA, CWA, Section 106 of the NHPA, and Section 307 of the CZMA. Each of these statutes has been taken into account in the preparation of this EIS. Table 1.5-1 lists the major federal, state, and local permits, approvals, and consultations identified for the construction and operation of the Project. Table 1.5-1 also provides the dates or anticipated dates when Aguirre LLC commenced or anticipates commencing formal permit and consultation procedures.

Section 7 of the ESA states that any project authorized, funded, or conducted by any federal agency should not "…jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined…to be critical…" (16 USC 1536(a)(2)(1988)). The FERC is required to determine whether any federally listed or proposed threatened or endangered species or their designated critical habitat occur in the vicinity of the proposed Project and conduct consultations with the FWS and/or NMFS, if necessary. If, upon review of existing data or data provided by Aguirre LLC, the FERC determines that these species or habitats may be affected by the Project, the FERC is required to prepare a Biological Assessment (BA) to identify the nature and extent of adverse impact, and to recommend measures that would avoid the habitat and/or species, or would reduce potential impact to acceptable levels. Section 4.6 provides information on the status of this review.

Section 106 of the NHPA requires that the FERC take into account the effects of its undertakings on properties listed, or eligible for listing, in the National Register of Historic Places (NRHP), including prehistoric or historic sites, districts, buildings, structures, objects, or properties of traditional religious or cultural importance, and to afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment on the undertaking. Aguirre LLC, as a non-federal party, assisted the FERC in meeting its obligations under Section 106 by preparing the necessary information, analyses, and recommendations under ACHP regulations in 36 CFR 800 for the State Historic Preservation Office (SHPO). Section 4.9 of this EIS provides information on the status of this review.

Aguirre LLC must comply with Sections 401, 402, and 404 of the CWA. Water quality certification (Section 401) has been delegated to the EQB, with review by the EPA. Water used for hydrostatic testing that is point-source discharged into waterbodies would require an NPDES permit (Section 402) issued by the EPA. The offshore burial of the pipeline would require a Dredge-and-Fill Permit (Section 404).

The Energy Policy Act of 2005 and Section 3 of the NGA require us to consult with the U.S. Department of Defense to determine if there would be any impacts associated with the Project on military training or activities on any military installations. The U.S. Department of Defense, in a letter on July 21, 2014, indicated that there would likely be no impacts from the proposed action.

The CZMA calls for the "effective management, beneficial use, protection, and development" of the nation's coastal zone and promotes active state involvement in achieving those goals. As a means to reach those goals, the CZMA requires participating states to develop management programs that demonstrate how those states will meet their obligations and responsibilities in managing their coastal areas. In Puerto Rico, the PRPB administers the CZMP and would conduct a consistency determination concurrent with Aguirre LLC's filing of an application for a conditional use permit. The CZMP is discussed further in section 4.7.3.

TABLE 1.5-1

Major Permits, Approvals, and Consultations for the Aguirre Offshore GasPort Project

Agency	Permit/Approval/Consultation	Status
Federal		
COE	Section 10 Rivers and Harbors Act Permit [a]	Filed application July 2013
	Section 404, CWA, Dredge-and-Fill Permit	Submittal pending
EPA	Spill Prevention, Control and Countermeasure Plan	Would obtain prior to construction
	NPDES	Permit application submitted July 2013; EPA completeness determination August 2013; anticipate receipt prior to construction
	PSD and Nonattainment New Source Review air permits	Filed PSD Non-Applicability Analysis September 2013; EPA provided comments November 2013
USCG, Sector San Juan	LOR and WSA and Report	WSA submitted April 2013; responses to USCG comments filed July 2013; LOR received May 2, 2014
FWS	Consultation regarding Threatened and Endangered Species and Incidental Take Permit (if required)	Initiated March 2012; revised draft BA filed February 2014; anticipate receipt prior to construction
	Consultation regarding West Indian Manatee	Initiated March 2012; revised draft BA filed February 2014; anticipate receipt prior to construction
NMFS	Consultation regarding Threatened and Endangered Species and Incidental Take Permit (if required)	Initiated March 2012; revised draft BA filed February 2014; anticipate receipt prior to construction
	Consultation regarding EFH	Initiated March 2012; EFH analysis filed April 2013; anticipate receipt prior to construction
	Consultation regarding marine mammals (except West Indian Manatee)	Initiated March 2012; a revised draft BA filed February 2014; anticipate receipt prior to construction
ACHP	Provide opportunity to comment under Section 106 of the NHPA	No submittal anticipated; ACHP may comment on FERC proceeding
DOT, PHMSA	Compliance with 49 CFR 192.3270 Pipeline Burial	Anticipate receipt prior to construction
U.S. Department of Defense	Consultation regarding impacts on military operations	Initiated by FERC April 2012; July 21, 2014 letter received indicating no impacts.
Commonwealth		
DNER	Federal and Commonwealth Joint Permit Application for Water Resource Alterations In Waters, Including Wetlands, and submerged lands under state coastal waters, of Puerto Rico [a]	Filed application July 2013; responses to comments filed August 2013; anticipate receipt prior to construction
PRPB	Puerto Rico Coastal Zone Management Consistency Certificate [a]	Filed application July 2013; responses to comments filed January 2014; anticipate receipt prior to construction
	Transaction Consultation and Location Pre-Consultation	Transaction Consultation accepted March 2014; Location Consultation initiated May 2014; anticipate receipt prior to construction
EQB	Section 401 Water Quality Certification [a]	Filed May 2014; anticipate receipt prior to construction
	Emission Source Construction Permit according to Rule 203 of the Regulations for the Control of Atmospheric Pollution (RCAP)	Filed application August 2013; anticipate receipt prior to construction

TABLE 1.5-1 (cont'd)

Major Permits, Approvals, and Consultations for the Aguirre Offshore GasPort Project

Agency	Permit/Approval/Consultation	Status
	Title V permit shield approval by application of renewal of final Title V operating permit of PREPA Aguirre or revision to initial Title V operating permit application to include the Offshore GasPort Project	Anticipate filing after issuance of Emission Source Construction Permit and Location Approval
	New final Title V emission source operating permit	Anticipate filing within 6 months after facility begins operations
State Historic Preservation Office	Consultation regarding cultural resources issues according to Section 106 of the NHPA	SHPO concurrence received July 2, 2013
Puerto Rico Institute of Culture	Consult and issue recommendation for construction to the Puerto Rico Permit and Endorsement Management Office	Initiated October 2013; endorsement received August 11, 2014
PMO	Environmental document according to Puerto Rico Environmental Public Policy Act	Anticipate receipt prior to construction
	Construction Permit	Anticipate filing in second quarter 2015
	General Consolidated Permit • Erosion and Sediment Control • Dust and Fugitive Emissions • Solid Waste Generation and disposal (Recycling Plan)	Anticipate filing in second quarter 2015; anticipate receipt prior to construction
	Use Permit • Health Department Endorsement • Fire Department Endorsement	Anticipate filing in second quarter 2015; anticipate receipt prior to construction
Puerto Rico Ports Authority	Concession for use of territorial waters and submerged lands	Filed March 2014; anticipate receipt prior to construction

[a] Joint permit application with the COE, DNER, EQB, and PRPB.

The CAA was enacted by Congress to protect the health and welfare of the public from the adverse effects of air pollution. The CAA is the basic federal statute governing air pollution. Federal and state air quality regulations established as a result of the CAA include, but are not limited to, Title V operating permit requirements and PSD review. The EPA is the federal agency responsible for regulating stationary sources of air pollutant emissions. Air quality impacts that could occur as a result of construction and operation of the Project are evaluated in section 4.10.1 of this EIS.

Aguirre LLC is responsible for all permits and approvals required to implement the Aguirre Offshore GasPort Project, regardless of whether they appear in table 1.5-1. However, any state or local permits issued with respect to jurisdictional facilities must be consistent with the conditions of any authorization the Commission may issue. Although the FERC encourages cooperation between applicants and state and local authorities, this does not mean that state and local agencies, through application of state and local laws, may prohibit or unreasonably delay the construction or operation of facilities approved by the FERC.

2.0 DESCRIPTION OF PROPOSED ACTION

2.1 DETAILED DESCRIPTION OF PROPOSED PROJECT

The Project would involve the construction and operation of an offshore LNG terminal and subsea pipeline linking the receiving facility to PREPA's existing onshore Aguirre Plant. The Project would consist of an Offshore GasPort (berthing platform and FSRU) and 4.0-mile-long (6.4 km) subsea pipeline. A non-jurisdictional FSRU would be moored at the offshore berthing platform. The LNG terminal would be located approximately 3 miles (5 km) off the southern coast of Puerto Rico, about 1 mile (1.6 km) outside of Jobos Bay, near the towns of Salinas and Guayama. Aguirre LLC is also proposing to utilize a construction office, contractor staging area, and an existing dock within the Aguirre Plant property. Figure 2.1-1 shows an overview map of the Project location and facilities.

In a letter dated September 29, 2014, Aguirre LLC noted that following input from the Aguirre community, the point where the offshore pipeline came ashore was shifted 200 feet (70 m) to the south end of the bulkhead. This change, which is reflected in this final EIS, reduced the offshore pipeline length from 4.1 to 4.0 miles (6.6 to 6.4 km).

2.1.1 Offshore Berthing Platform

The offshore berthing platform would be a fixed platform carrying topside facilities and two berths, one on each side of the fixed platform. The platform would be designed for long-term mooring of an FSRU and for receipt of LNG carriers ranging in size from 163,500 to 283,800 yd^3 (125,000 to 217,000 m^3). The FSRU would be moored at a berth on the north (landward) side of the platform, and the LNG carriers would temporarily dock on the south (seaward) side of the platform while unloading LNG cargo. LNG cargo would be transferred from the LNG carrier via topside conventional LNG loading arms and cryogenic piping to the FSRU for storage. Figures 2.1.1-1 and 2.1.1-2 show a model diagram and schematic drawing of the facilities, respectively.

Specific components of the proposed offshore berthing platform include:

- two LNG vessel berths on opposing sides;
- berthing fenders and mooring and breasting dolphins at each berth;
- at each berth, LNG loading arms, LNG drain tanks, and LNG piping between the LNG loading arms to facilitate transfer of LNG between vessels;
- high-pressure gas loading arms at one berth to connect to the FSRU and facilitate natural gas discharge to the send-out pipeline;
- utility platforms providing docking facilities for lifeboats and service vessels, control and switch gear rooms, utility equipment, personnel access/egress, and laydown and work areas; and
- utility systems, including process support systems, electrical systems, safety systems, gas- and diesel-fueled electricity generators, nitrogen generators, electric seawater pumps, diesel fire pumps, diesel storage tanks, lubrication oil storage tanks, potable water and waste water tanks, sewage treatment unit, and fire water monitors.

Figure 2.1-1
Project Location Map
Aguirre Offshore GasPort Project

Figure 2.1.1-1
Model Diagram of the Proposed Offshore Terminal
Aguirre Offshore GasPort Project

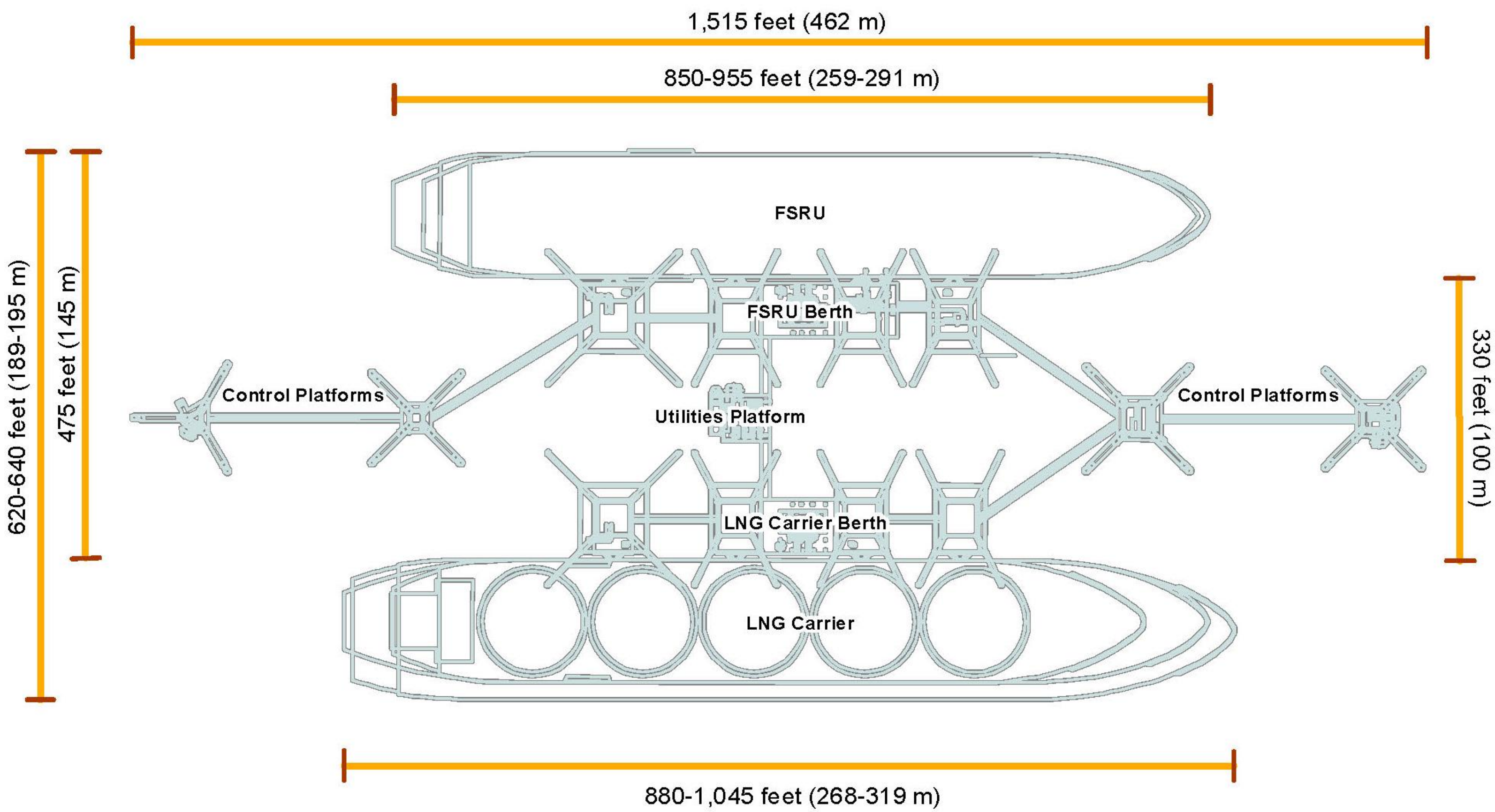


Figure 2.1.1-2
Schematic Drawing of the Proposed Offshore Terminal
Aguirre Offshore GasPort Project

2.1.2 Floating Storage and Regasification Unit

Aguirre LLC would utilize one of Excelerate Energy's existing EBRVs as the FSRU. EBRVs are purpose-built LNG tankers that incorporate onboard equipment for the vaporization of LNG and delivery of high-pressure natural gas.

Excelerate Energy currently has nine EBRVs in its fleet. The EBRV that would be utilized for the Project, referred to as the FSRU throughout the remainder of the document, would have an overall length of approximately 955 feet (291 m) and a design draft of 38 feet (11m). The FSRU would provide 197,400 yd^3 (150,900 m^3) of LNG storage capacity and would be capable of discharging regasified LNG at a contractually guaranteed sustained rate of up to 500 MMscf/d, with peaking rates of up to 600 MMscf/d. However, based on the information provided by Aguirre LLC, the Aguirre Plant would only be able to utilize 225 MMscf/d. The additional capacity on the FSRU is discussed further in section 2.8. The LNG regasification process is discussed in section 2.6.3.

The FSRU would employ a membrane cargo containment system composed of reinforced tanks with a membrane of high nickel alloy stainless steel and an insulation system that allows greater resistance to LNG movement during adverse sea conditions if the FSRU needs to depart the offshore berthing platform.

2.1.3 Subsea Interconnecting Pipeline

The subsea interconnecting pipeline would extend approximately 4.0 miles (6.4 km) from the Offshore GasPort in the Caribbean Sea, northward through the Boca del Infierno pass, and across the basin of Jobos Bay to the Aguirre Plant property where it would connect with existing Aguirre Plant piping (see figure 2.1-1). The subsea interconnecting pipeline would consist of an 18-inch-diameter (46 cm) steel pipe with a maximum allowable operating pressure of 1,450 pounds per square inch (psi) (9,997 kilopascals [kPa]). Prior to shipment of the pipe to the Project site, the manufacturer would coat the pipe with concrete for an outside diameter of approximately 21 inches (53 cm). All of the subsea pipeline would be concrete coated with the exception of the pipeline located at the pipe bend locations. In the pipe bend locations, concrete mats would be placed above the buried steel pipeline.

2.2 LAND REQUIREMENTS

The land requirements for the Project are summarized in table 2.2-1 and illustrated on figure 2.2-1. As discussed above, the majority of the Project facilities would be located offshore, including the Offshore GasPort and subsea pipeline. The installation of the subsea pipeline would require approximately 85.5 acres (88.0 cuerdas) at the water surface and would directly impact 54.4 acres (56.0 cuerdas) of the seafloor. Direct impacts would include a 20-foot-wide (6 m) workspace on the seafloor in coral reef areas, 40-foot-wide (12 m) workspace along the remainder of the pipeline, and additional temporary workspace (ATWS) at the PIs and shore approach. The permanent impacts on the seafloor would consist of the 8-foot-wide (2.4 m) concrete mats placed over the pipeline in coral reef areas (1,700-foot [518 m] crossing at the Boca del Infierno pass); at points of inflection (PI) 3, 4 and 5; and a 1,300-foot-long (396 m) section at the onshore approach. In addition, 1.5 acres (1.5 cuerdas) of previously disturbed land within the existing Aguirre Plant property would be required for a temporary staging and support area where the subsea pipeline would reach landfall (see figure 2.2-2). Construction of the Offshore GasPort would impact approximately 75.5 acres (77.7 cuerdas) of the seafloor of which approximately 22.3 acres (22.9 cuerdas) would be permanently impacted during operation.

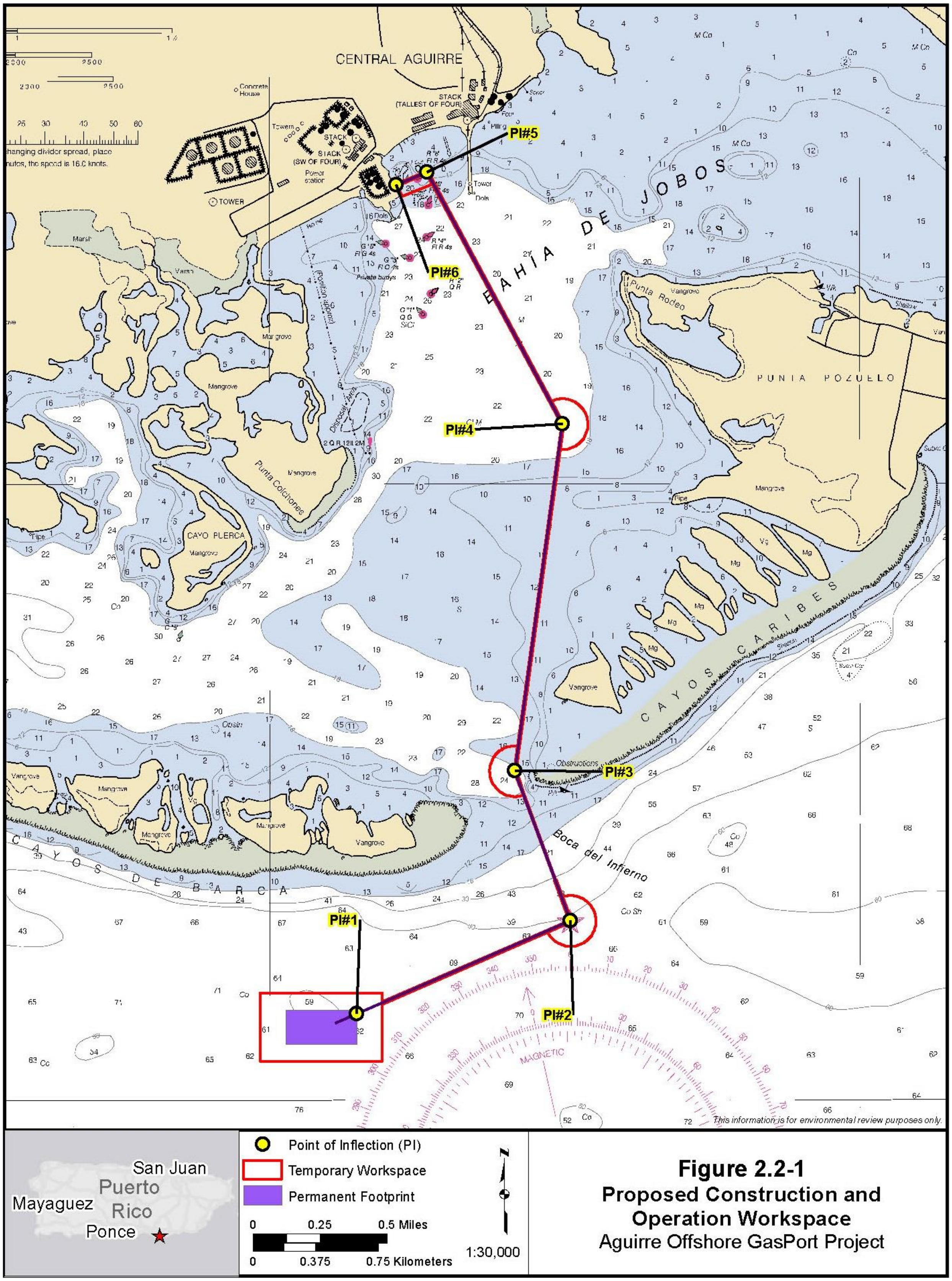


Figure 2.2-1
Proposed Construction and Operation Workspace
Aguirre Offshore GasPort Project

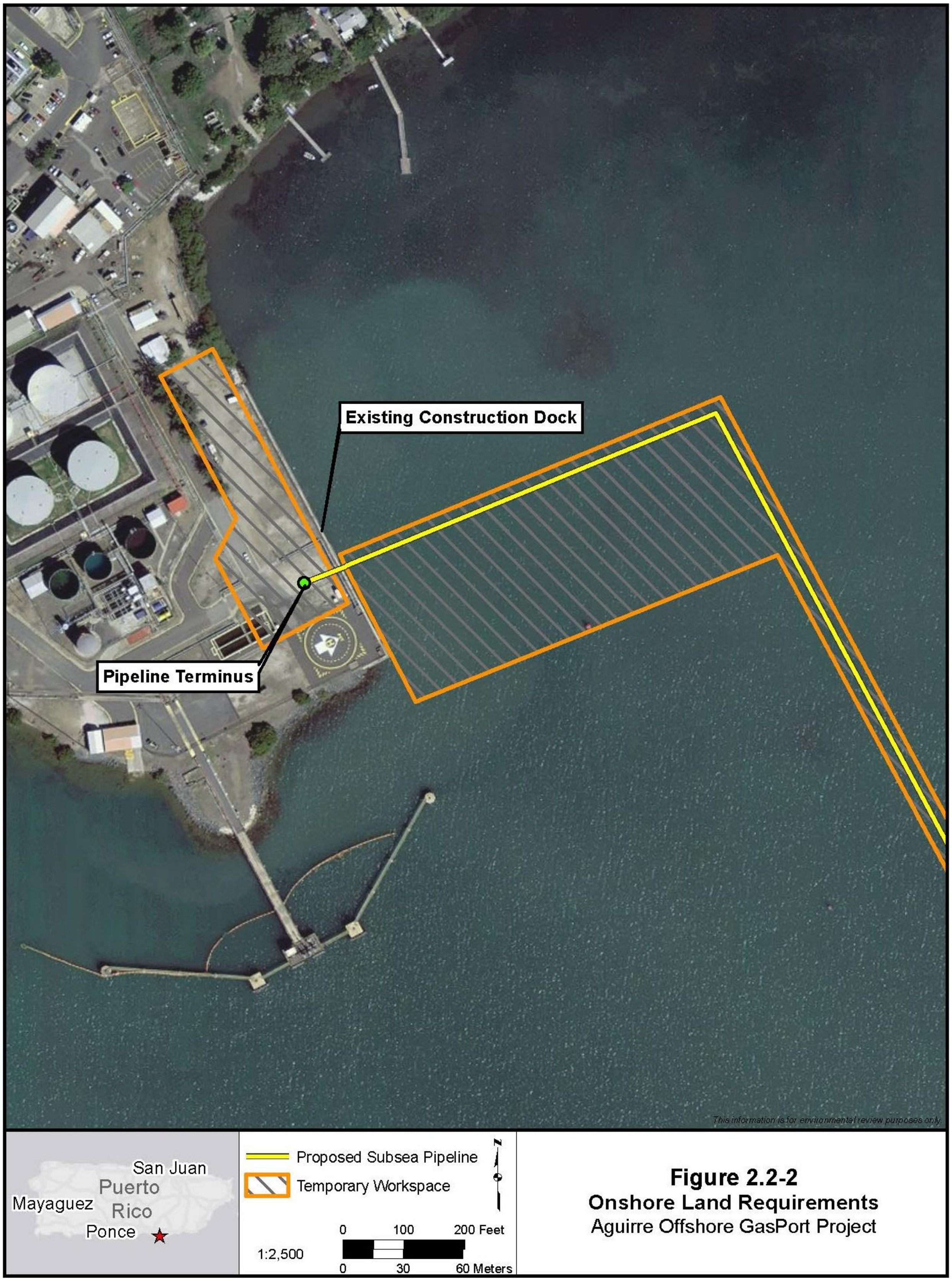


Figure 2.2-2
Onshore Land Requirements
Aguirre Offshore GasPort Project

TABLE 2.2-1

Summary of Proposed Construction and Operation Impacts Associated with the Aguirre Offshore GasPort Project

Project Component	Temporary Impacts During Construction (acres [cuerdas])		Permanent Impacts During Operation
	Water Surface	Seafloor [a]/Upland	
Offshore GasPort	75.5 (77.7)	75.5 (77.7)	22.3 (22.9)
Subsea Interconnecting Pipeline	48.9 (50.3)	17.8 (18.3)	0.6 (0.6) [b]
Offshore Lay Barge Construction Areas	36.6 (37.7)	36.6 (37.7)	0.0
Onshore Temporary Staging and Support Area [c]	0.0	1.5 (1.5)	0.0
USCG Safety Zone	0.0	0.0	303.3 (312.3)
TOTAL	**161.0 (165.7)**	**131.4 (135.2)**	**326.2 (335.8)**

[a] Includes direct impacts on the seafloor from mechanical activities (e.g., pipeline installation) and associated sedimentation. The proposed construction methods for the subsea interconnecting pipeline do not include use of mooring anchors or cables; therefore, no temporary workspace would be required for the sweep of mooring anchor chains or cables. Estimates of the Offshore GasPort construction includes mooring and anchor chain acreages.

[b] Permanent impacts include areas where the pipeline would be above grade and/or covered with concrete mats.

[c] Located within the existing Aguirre Plant property.

2.3 CONSTRUCTION PROCEDURES

2.3.1 Construction and Support Vessels

The construction of the offshore Project facilities would require the use of a variety of marine vessels, including:

- crane barges, secured using spud-legs, used during the fabrication of the Offshore GasPort and the lowering of some pipeline segments;
- a shallow-water lay barge, secured using spud-legs, used for the pipeline fabrication (e.g., welding and inspection);
- a dive support vessel, typically secured using spud-legs, used for activities such as tie-ins, hydrotesting, and other dive-related functions;
- vessel support tugs used to spot the lay barge, other floating equipment, and to float pipeline segments into place;
- crew/supply boats used to shuttle personnel and supplies from the landside pier to the lay barge and dive support vessels; and
- pipe transport barges, shuttled by tugs, used to transport pipe segments from the pipe yard and the lay barge.

Aguirre LLC proposes to use the spud-leg anchoring system to minimize its seafloor impact. Spud-leg is a barge pin-anchor system used to secure floating work platforms to the seafloor bed to prevent general movement and drifting from the work area. The spud-legs are lowered fore and aft of the barge thus anchoring the barge.

Site preparation for set-up and completion of the Offshore GasPort and pipeline facilities would be conducted onshore within the Aguirre Plant property.

2.3.2 Offshore Berthing Platform

The offshore berthing platform would consist of tubular steel structures (jackets), pile structures, steel decks, and topside equipment. Aguirre LLC would pursue the use of prefabricated modular designs, made up of precast elements fabricated prior to delivery rather than on site. Use of precast elements would reduce the time and labor required on site, thereby reducing the potential safety and environmental impacts associated with working in a marine environment.

Aguirre LLC would place 13 structures into the seafloor, 9 structural jackets for the utilities platform and berthing dolphins, and 4 tri/quad pile structures for the smaller mooring dolphins. Aguirre LLC would use a barge-mounted crane to lift these structures from transport barges and then lower them into the water. Each structural jacket would be placed on mud mats on the seafloor prior to installation. A vibratory pile driver or diesel pile hammers would be used to drive the main piles through hollow jacket sleeves into the seafloor. The tri/quad piles would also be installed using vibratory or diesel pile hammers.

Aguirre LLC would install the deck sections, module support frames, and module packages following the installation of the structural jackets and tri/quad piles. The modules would then be connected to the jackets or pile structures as designed.

Aguirre LLC would transport the topside equipment to the platform on prefabricated skid packages and use a barge crane to lift the equipment into place and secure them to the pier. All necessary connections would then be completed and the equipment would be tested.

2.3.3 Floating Storage and Regasification Unit

As discussed above, Aguirre LLC would utilize one of Excelerate Energy's existing EBRVs as the FSRU; therefore, construction of a new FSRU would not be required for the Project.

2.3.4 Subsea Interconnecting Pipeline

The subsea pipeline would start at the connection to the Offshore GasPort located south of the Cayos de Barca and Cayos Caribes, cross through the Boca del Infierno pass, cross Jobos Bay from south to north, and connect to the existing Aguirre Plant. The water depths for the subsea pipeline vary from approximately 70 feet (21 m) deep to approximately 8 feet (2 m) deep in nearshore areas. Aguirre LLC proposes to use a crane (derrick) barge, support tugs, a pipe lay barge, dive-support boats, and two shallow-draft pipe transport barges to install the pipeline. The lay barge welds the pipeline together and with the assistance of the crane barge and tugs, sets it on the seafloor.

The pipeline segments would be fabricated on the pipe lay barge that would be secured to the bottom with spud-legs, and would not use dynamic positioning or anchors for the major marine activities. Smaller boats (tugs, service vessels) would follow typical marine procedures and use anchors as necessary. Any anchoring would occur within the temporary workspace area of the Project.

Figure 2.3.4-1 illustrates the typical layout for the subsea pipeline lay technique. The subsea pipeline would be installed in five segments that are defined by PIs along the pipeline (see figure 2.3.4-2). The segments include:

- Segment 1 – PI 1 (Offshore GasPort) to PI 2, mileposts (MP) 0.0 to 1.0;
- Segment 2 – PI 2 to PI 3, MPs 1.0 to 1.6;
- Segment 3 – PI 3 to PI 4, MPs 1.6 to 3.0;
- Segment 4 – PI 4 to PI 5, MPs 3.0 to 4.0; and
- Segment 5 – PI 5 to PI 6 (shore approach and tie-in), MPs 4.0 to less than 4.1.

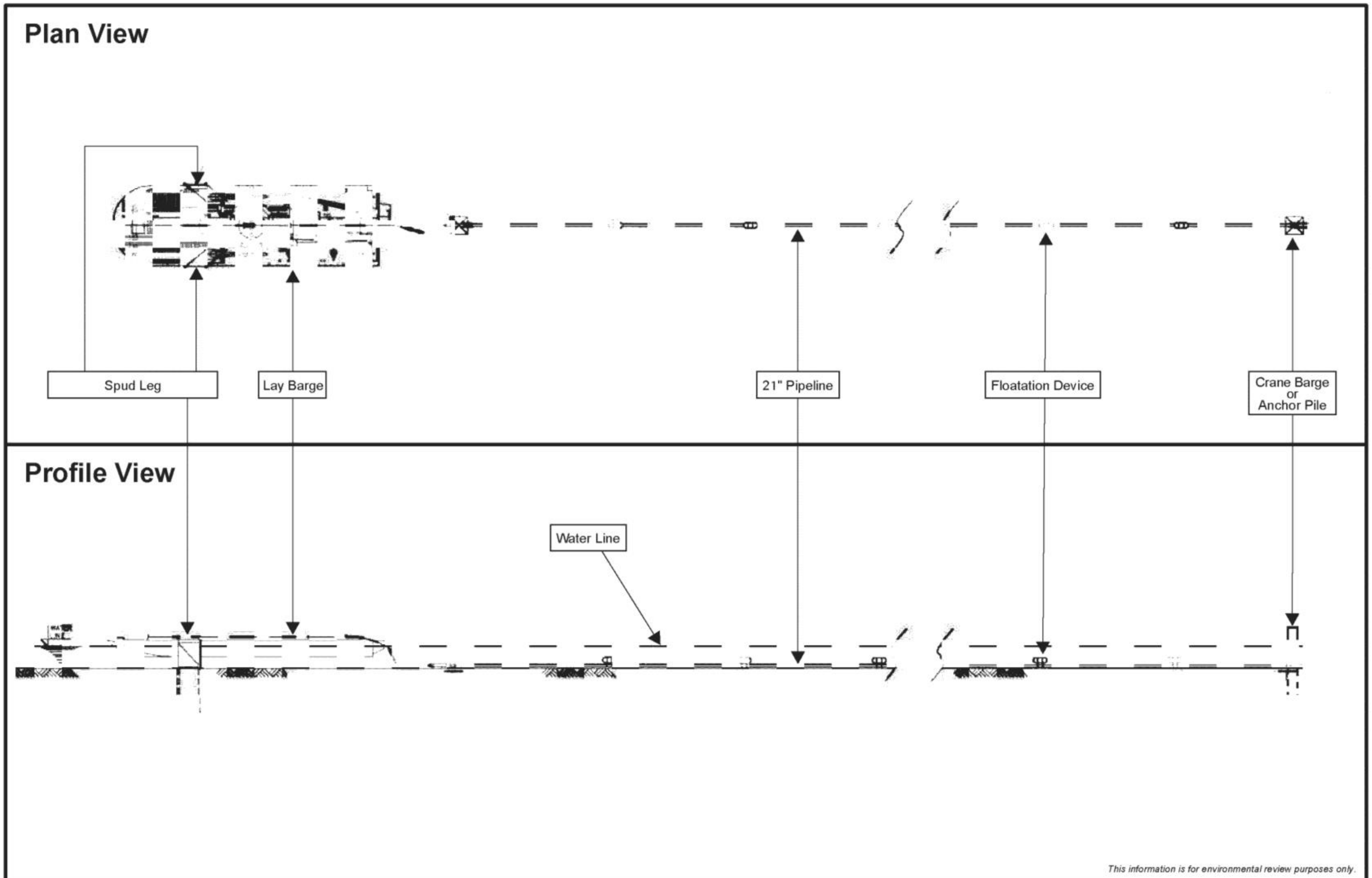


Figure 2.3.4-1
Subsea Pipeline Lay
Aguirre Offshore GasPort Project

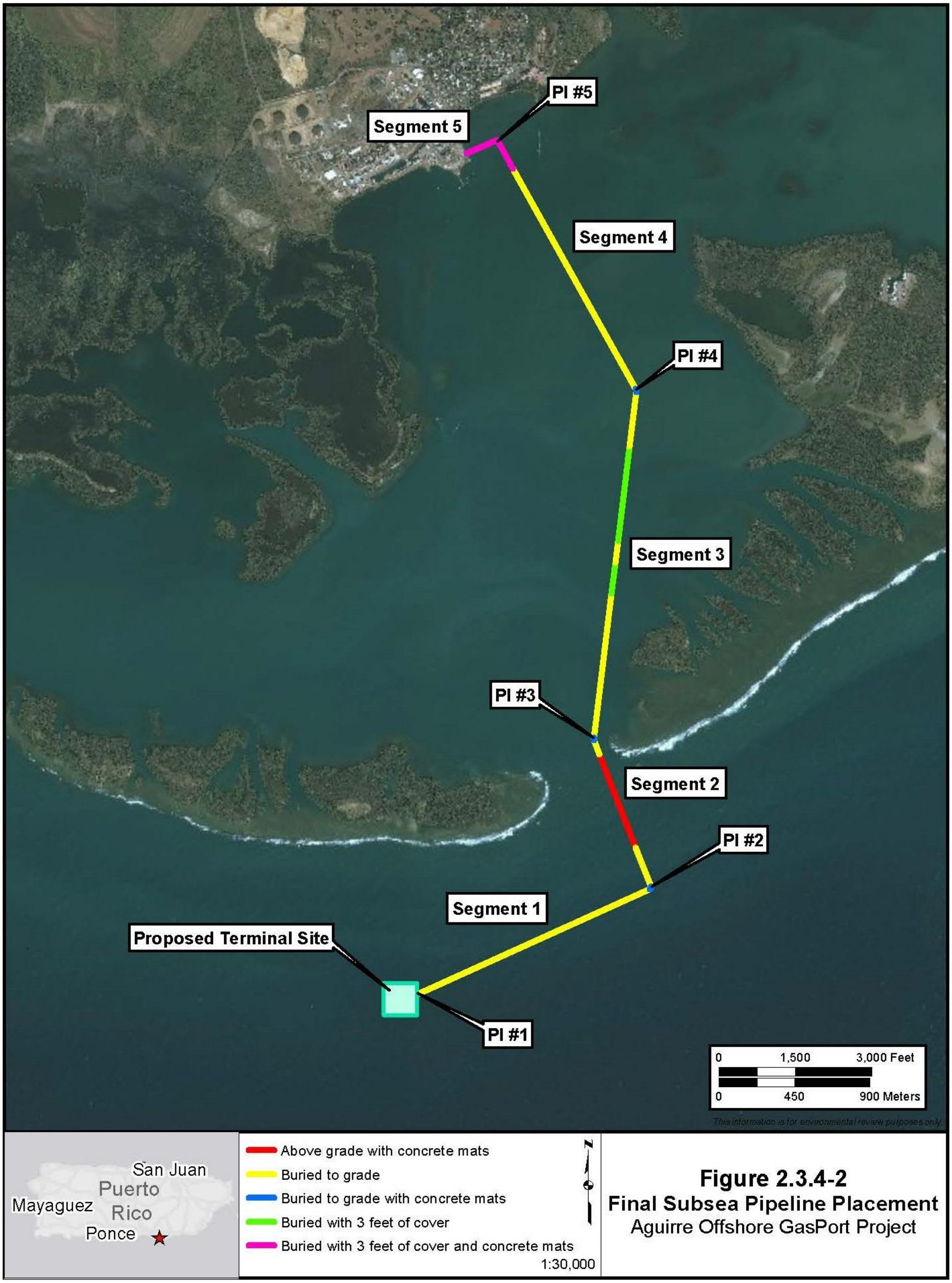


Figure 2.3.4-2
Final Subsea Pipeline Placement
Aguirre Offshore GasPort Project

Construction in the near and offshore areas would take approximately 80 days to complete. Phase 1 activities to lay the pipeline would occur for about 45 days, and Phase 2 activities to bury the pipeline would take about 50 days with the two phases overlapping for about 15 days. Aguirre LLC estimates that each individual segment would average about 8 to 10 days for Phase 1 to weld and string the pipe and about 10 days for Phase 2 to bury the pipe. Pipe welding and stringing activities would take place during daylight hours. Pipe burial activities would take place around the clock to achieve maximum efficiency in lowering the pipeline.

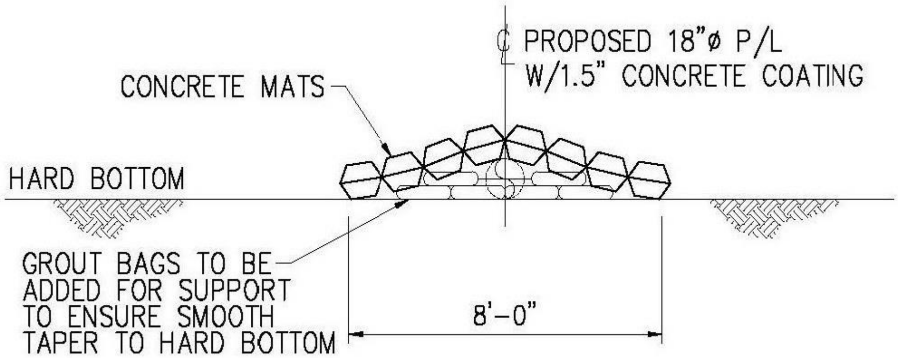
Segments constructed outside of Jobos Bay (Segments 1 and 2) are considered deep-water pipeline segments, while construction within Jobos Bay (Segments 3, 4, and 5) is considered shallow-water construction. The deep-water segments would be fabricated within the shallow water area and pulled by marine tugs to their final location for installation. The shallow-water segments would be welded, the welds non-destructively inspected and coated, and then lowered to the sea bottom. The pipeline would then be buried to the required depth using a diver-operated jet/suction tool. Figure 2.3.4-2 also illustrates the portions of the pipeline that would be above grade, buried to below grade, buried with 3 feet of cover, and areas where concrete mats would be placed. Figures 2.3.4-3, 2.3.4-4, and 2.3.4-5 illustrate the profile views of the pipeline where it has been placed above grade, buried to below grade, and buried with 3 feet of cover, respectively.

2.3.4.1 Phase 1: Pipe Lay Procedures

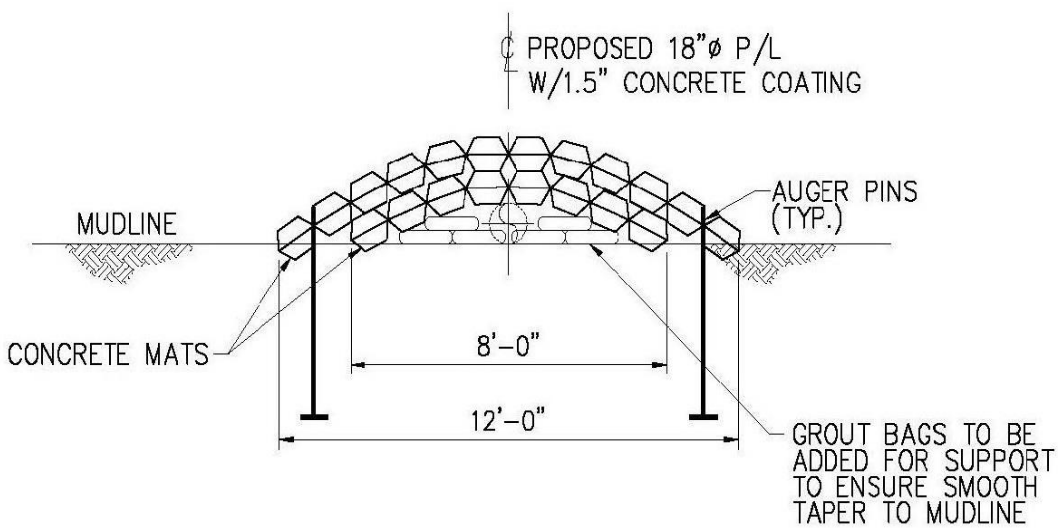
At the start of pipeline construction, Aguirre LLC would position its pipe lay barge at PI 4 within Jobos Bay. A pipe lay barge is a complete seagoing construction facility that typically remains offshore for the duration of a project. Pipe lay barges vary in size but a typical pipe lay barge may be 400 feet long (122 m) by 120 feet wide (37 m). An assembly line of welding, coating, and inspection stations would be set up on the pipe lay barge deck. The pipe lay barge would be moved via a tug to set up at the PI 4 location and, using spud-legs fore and aft of the barge, would act as a platform for the welding and stringing of the pipe. Once the pipe lay barge is positioned, winch wire from the crane barge would be attached to the pipe pull head on the pipe lay barge. As the pipeline is fabricated, it would be slowly lowered over a ramp equipped with a pipe guide along the winch wire and into the water. The crane barge would use a winch wire to maintain tension on the pipeline profile in the water column and prevent the pipeline from touching the seafloor until the entire pipeline segment is completed. Once the pipe segment has been welded and properly located above the seafloor, the winch wire would be released to allow the pipe segment to be lowered into place by the crane barge and tug assist.

The crane barge would then be moved to the next position, and the pipe lay barge would be turned to feed pipe for the next section of pipeline. This process would be repeated to install each offshore pipeline section. To complete the pipeline, the crane barge would be stationed at each PI, both ends of the pipeline segments would be lifted, and an over-the-side tie-in would be completed. The pipe joints would be bent in the factory and stress tested prior to installation; no pipeline joints would be bent in the field or on the pipe lay barge. Once the tie-in is completed, the pipeline would be lowered to the seafloor. The pipeline would have a 1.5-inch-thick (3.8 cm) concrete coating to become negatively buoyant and sink into place.

A detailed description of the construction methods for deep-water and shallow-water segments, as well as pipeline burial methods, are described below.

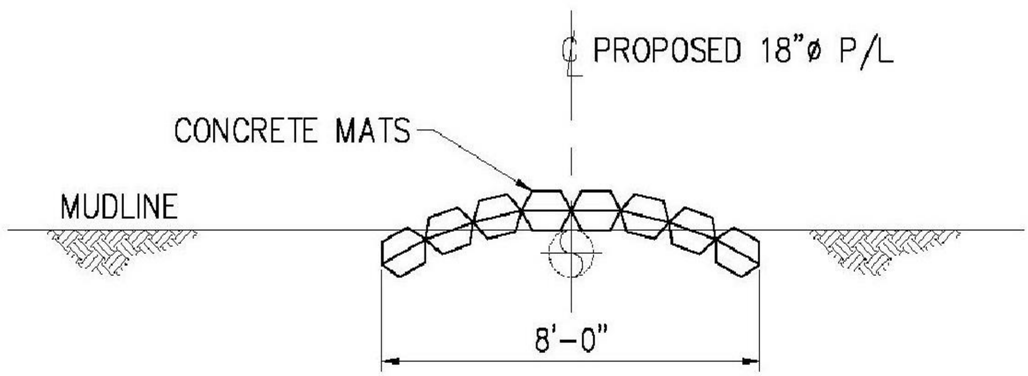


Areas Placed Above Grade With Concrete Mats

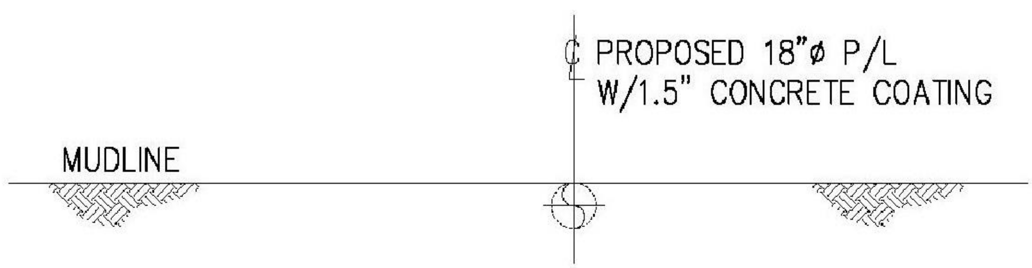


Areas Placed Above Grade With Two Concrete Mats and Anchor Pins

Figure 2.3.4-3
Above Grade Typical Drawings
Aguirre Offshore GasPort Project

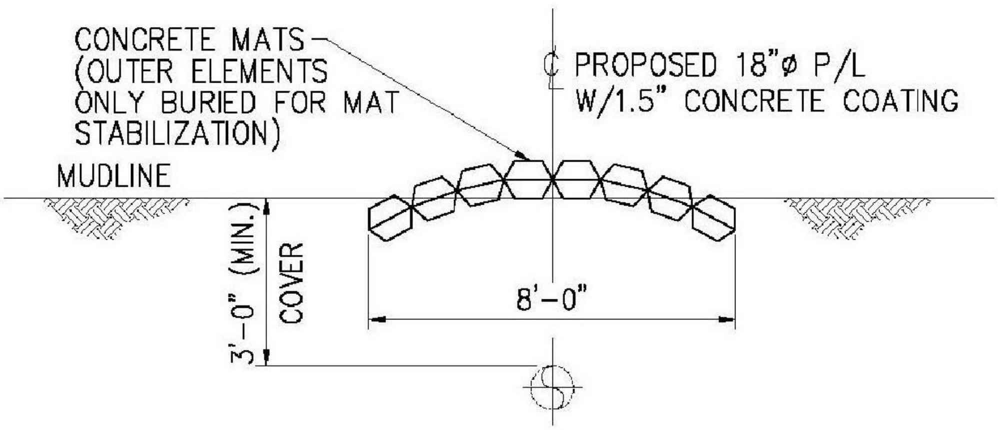


Areas Buried to Below Grade With Concrete Mats

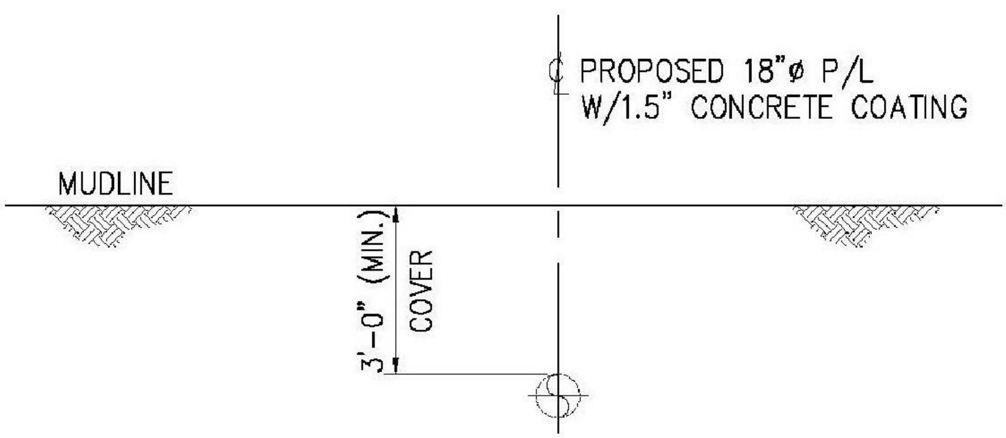


Areas Buried to Below Grade Without Concrete Mats

Figure 2.3.4-4
Burial to Below Grade Typical Drawings
Aguirre Offshore GasPort Project



Areas Buried With 3 feet of Cover and Concrete Mats



Areas Buried With 3 Feet of Cover and Without Concrete Mats

Figure 2.3.4-5
Burial With 3 Feet of Cover Typical Drawings
Aguirre Offshore GasPort Project

Deep-Water Pipe Lay Procedures

Segment 1 would be constructed on the pipe lay barge positioned at PI 4. The pipeline would be fabricated on the pipe lay barge and would be pulled into the water using the winch wire from the crane barge as sections of the pipe segment are fabricated. As sections of each segment are completed, control lines and flotation buoys would be placed on the pipeline to keep it off of the seafloor as it would be lowered into the water. The completed pipeline segment would be maintained above the seafloor using flotation buoys until sea conditions allow tugs to tow it through the Boca del Infierno pass to the crane barge, which would be positioned near PI 1. The crane barge would control the end of the pipeline segment while the flotation buoys are removed by the tugs or divers. The pipeline would then be flooded and gradually lowered to the seafloor.

Segment 2 would also be constructed on the pipe lay barge positioned at PI 4. As sections of the pipeline segment are fabricated, control lines and flotation buoys would be placed on the pipeline and it would be lowered from the pipe lay barge. When sea conditions allow, two tugs would tow the completed segment to the crane barge positioned at PI 2. The crane barge would control the end of the pipeline segment, and the flotation buoys would then be removed by tugs or divers in a controlled fashion. The pipeline would then be flooded and allowed to gradually descend to the seafloor.

Shallow-Water Pipe Lay Procedures

Segment 3 would be fabricated on the pipe lay barge positioned at PI 4. The crane barge would be positioned at PI 3, and a winch wire cable would extend from the crane barge to the pipe lay barge. The wire would be connected to the pipeline pull head on the first section of pipeline and would extend back to the crane barge. As each section of pipeline is constructed, the winch wire cable would pull the pipeline section off of the pipe lay barge. Fixed buoyancy modules would be attached to the pipeline as it is pulled from the pipe lay barge, and the tension would be kept on the winch wire cable to control the depth of each section and prevent it from touching the seafloor until it is put into place. Once the pipeline section is in place, the fixed buoys would be removed; the pipeline then would be flooded and lowered into place.

Segment 4 would be fabricated on the pipe lay barge positioned at PI 4, although it would be oriented in the opposite direction from the segment 3 construction. The crane barge would be positioned at PI 5, and the winch wire cable system would be connected between the crane barge and the pipeline pull head on the first section of pipeline. Fixed buoyancy modules would be attached to the pipeline as it is pulled from the pipe lay barge, and the tension would be kept on the winch wire cable to control the depth of each section while it is put into place. Once the pipeline section is in place, the fixed buoys would be removed; the pipeline then would be flooded and lowered into place.

Segment 5 would be fabricated on the pipe lay barge positioned at PI 4. It would be welded and the segment would be pulled into place by the crane barge at PI 5.

After all five segments are in place, they would be welded to the adjacent segments. The onshore riser would also be constructed on the pipe lay barge. Once the riser is completed, the pipeline end of segment 5 at PI 6 would be raised out of the water using the crane barge. The riser would then be assembled, and segment 5 would be lowered back into place. To complete the onshore approach to the Aguirre Plant, a riser would be attached to the bulkhead wall, and an aboveground horizontal section of pipe on the landward side would be fixed to a concrete support. The riser would connect the seaward and landward sections of pipe, and would be protected using a riser guard that is connected to the bulkhead wall to prevent any possible collisions of any vessels with the pipeline. Figure 2.3.4-6 shows the proposed pipeline riser guard and protection of the vertical pipeline segment.

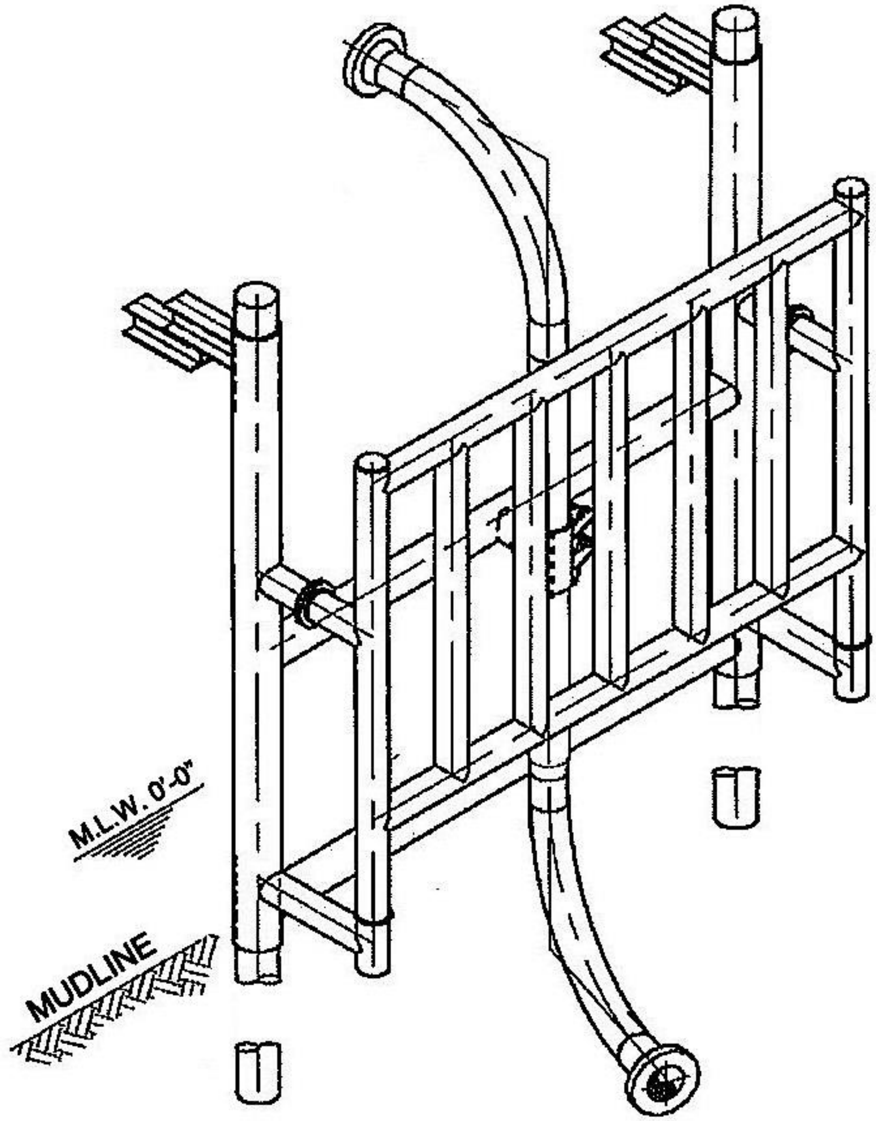


Figure 2.3.4-6
Pipeline Riser Guard at Onshore Approach
Aguirre Offshore GasPort Project

2.3.4.2 Phase 2: Pipeline Burial Procedures

After the pipeline is constructed and in place, the pipeline would be either buried or protected by concrete mats in accordance with 49 CFR 192. In places where the installed pipeline has a water depth of less than 12 feet (4 m) (portions of segments 3 and 4, and all of segment 5) the pipeline would be buried to a minimum of 3 feet (1 m) of cover to the top of the pipe (49 CFR 192.237(1)). In areas with a water depth greater than 12 feet (4 m) (portions of segment 3, all of segments 1 and 2), the pipeline would be buried so the top of the pipe is even with the natural grade of the seafloor (49 CFR 192.237(2)). In the areas with coral reef in segment 2, Aguirre LLC proposes to use concrete mats over the pipeline for protection rather than pipeline burial. Specific information pertaining to segment 2 pipeline protection is presented under the Concrete Mats section below.

Pipeline burial to a depth of 3 feet (1 m) of cover or to grade would be completed using a diver operated jet/suction tool connected to a pump onboard the crane barge. The unit would entail a jet/suction head, a hose connecting the jet/suction head to the pump, a discharge hose leaving the pump, a diffuser, and a frame with a turbidity curtain over the diffuser.

Prior to burying the pipeline, the diver would use a Pneumo Depth Gauge to take a depth reading of the natural sea bottom at each joint marker. The crane barge would then be positioned using the spud-legs to position the jet/suction pump over the section of pipeline to be buried. The jet/suction pump hose would be moved by the crane at about the same rate as the diver. The diffuser would be placed over the pipeline at a distance of 90 feet (27 m) behind the diver for the initial deployment and would be adjusted as necessary, depending on the rate of movement of the diver. The pump would jet or suction sediment from underneath the pipeline, redepositing the sediments from the discharge hose and diffuser over the pipeline areas that have been lowered to the appropriate depths. The pump would be equipped with a 200-foot-long (61 m) jet/suction hose and 120-foot-long (37 m) discharge hose. The pump would be positioned along the edge of the crane barge that the diver is using to maximize the amount of hose available. Due to limitations on the reach of the crane and the hose length, the crane barge and equipment would be moved and repositioned every 240 feet (73 m). Figure 2.3.4-7 shows a typical drawing of the jet/suction pump layout.

The pipeline would be buried in sections of not more than 120 feet (37 m) at a time. The burial would commence with the diver hand jetting along the side of the pipeline nearest to the crane barge, and jetting up to 120 feet (37 m) along the pipeline. The diver would then move to the other side of the pipeline and jet until returning to the original starting point, and by doing so removing soils on both sides of the pipeline. This initial pass would liquefy the sediment below the pipeline without causing a large sediment plume, and would establish the alignment for the pipeline lowering. On returning to the starting point, the diver would begin the suction pumping along the same length of pipeline that was previously jetted. The process would continue until the pipeline has reached the required burial depth. After a section of pipeline burial has been completed, the diver would complete the next 120 feet (37 m) section. The Pneumo Depth Gauge would be used to take readings at a maximum of every 50 feet (15 m) on the top of the pipe to ensure the pipeline has reached the appropriate depth prior to spoil redeposition. The actual burial depth would be based upon the difference between the current and initial depth readings. Aguirre LLC anticipates that two passes with the jet/suction pump would be required to bury the pipeline to meet the natural grade of the seafloor, and that five passes with the jet/suction pump would be required to achieve the 3 feet (1 m) of cover over the necessary sections of the pipeline.

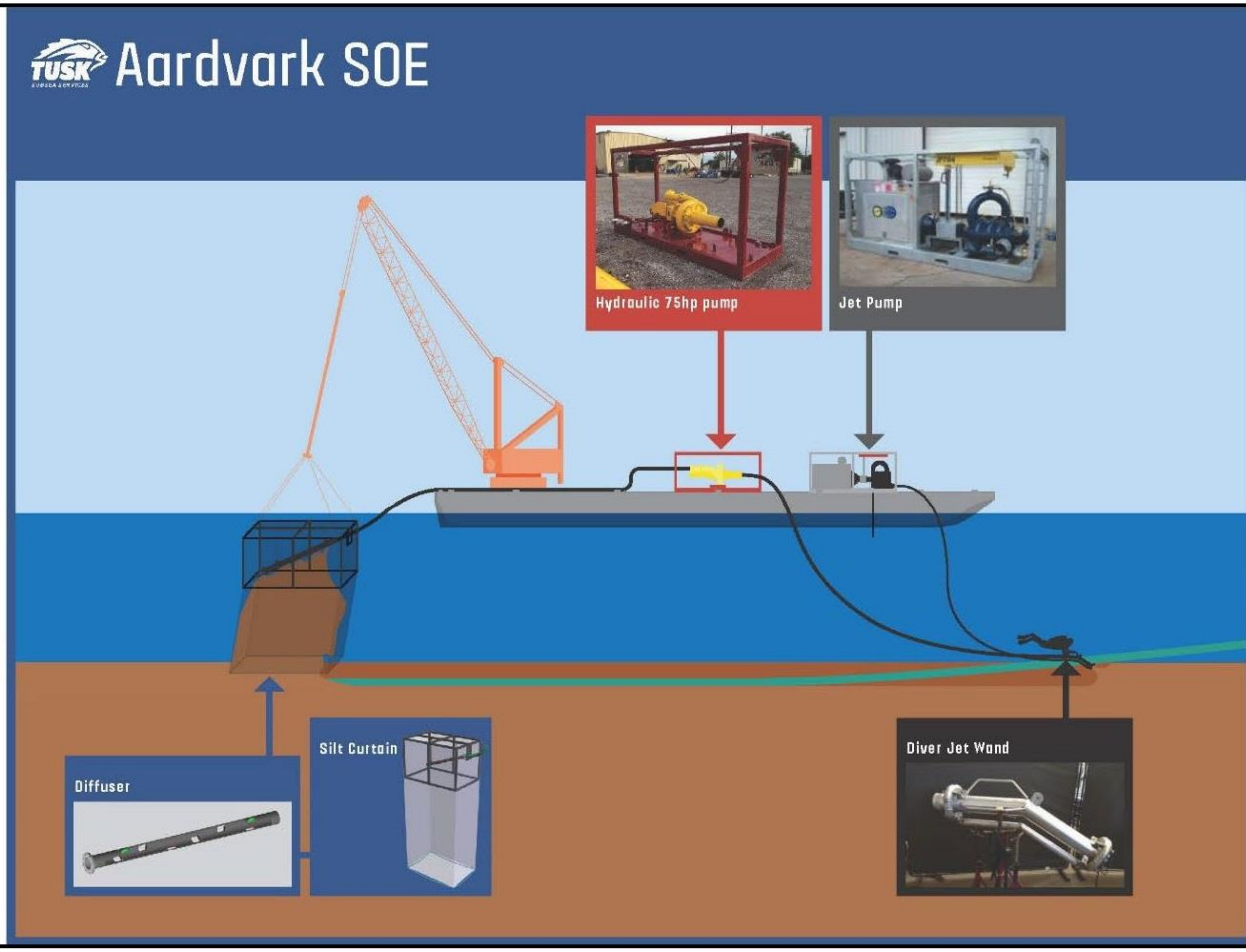


Figure 2.3.4-7
Jet/Suction Pump Typical Drawing
Aguirre Offshore GasPort Project

A diffuser head would be located at the end of the discharge hose to minimize the dispersion of spoils from the right-of-way. Figure 2.3.4-8 illustrates the proposed diffuser head and turbidity curtains. The diffuser head would be approximately 9 to 12 feet wide (3 to 4 m), to deposit spoils over the width of the disturbed area. The diffuser head would be suspended over the pipeline within a custom frame, which would be surrounded by a turbidity curtain to minimize the movement of sediments from the right-of-way. The diffuser head and frame would be tested prior to use along the entire pipeline route; the height of the diffuser over the pipeline and the amount of weight at the bottom of the turbidity curtain would be adjusted to maximize the distribution of sediment over the pipeline and minimize the movement of sediment from the right-of-way. The pipeline burial operation would operate 24 hours a day until the burial is complete.

Concrete Mats

Aguirre LLC would install concrete mats as an additional step to protect the pipeline at each PI. Each PI would have a single layer of concrete mats placed over the PI bend in the pipe to protect it from damage. It is estimated that a course of three mats (60 feet in total length by 8 feet wide) would be required to cover the pipeline bend. Mats are typically articulated concrete coverings that are about 20 feet long (6 m) and 8 or 12 feet wide (2 or 4 m), have a 9-inch (23 cm) thickness. This concrete mat design involves a flexible matrix of solid concrete cells that are closely linked and joined individually by polypropylene rope, resulting in a low profile when installed over the pipe. The mats are not typically anchored to the seafloor. Figure 2.3.4-9 shows a typical detail of the proposed concrete mat.

As proposed, Aguirre LLC would not bury the portion of segment 2 that crosses the reef, in order to lessen some of the impacts of pipeline installation on the reef habitat. Due to the elevation changes of the reef terrain, the pipeline would not be in direct contact with the seafloor throughout the entire reef crossing. Rather, the pipeline would be supported by stanchions, grout bags, and mats placed underneath the pipeline to support any span areas. The exact location of pipeline supports would be determined during the detailed engineering phase and finalized during pipeline construction.

After segment 2 is sufficiently supported and in place, a single layer of concrete mats would be placed over the entire section of pipeline that crosses the reef area. An additional layer of mats would be placed over the ends of the matted reef section, on both the north and south ends of reef section. The double-layer mats would be anchored using helix screw anchors to prevent the pipeline from moving within the reef. The helix screw anchors would be connected to the concrete mats using stainless steel anchor connectors, and the helix screw anchors would be flush with the top of the concrete mats. However, in section 4.5.2.4 we are recommending that Aguirre LLC consider the potential use of a water-to-water HDD in segment 2 to avoid direct and permanent impacts on coral reef habitat.

In addition to burying the pipeline for segment 5 (approximately 1,319 feet [402 m] between PI 5 and PI 6), Aguirre LLC proposes to also install reinforcing concrete mats on the seafloor over the top of the buried pipeline section in the onshore approach area. This would be an additional step to protect the pipeline in the unlikely event that a ship, barge, or boat nears the pipeline in this area. The concrete mats would be lowered over the pipeline using the crane barge. Instead of using helix-screw anchors for the mats at this location, the edges of the concrete mats would be keyed into the seafloor using the hand-jetting equipment.

Where the pipeline would transition from burial at natural grade to 3 feet (1 m) of cover, the pipeline elevation transition would not exceed a 1:25 slope. However, at the coral reef located along segment 2, the pipeline would be at a 1:25 slope to accommodate the transition between the shallow water and the deep water.

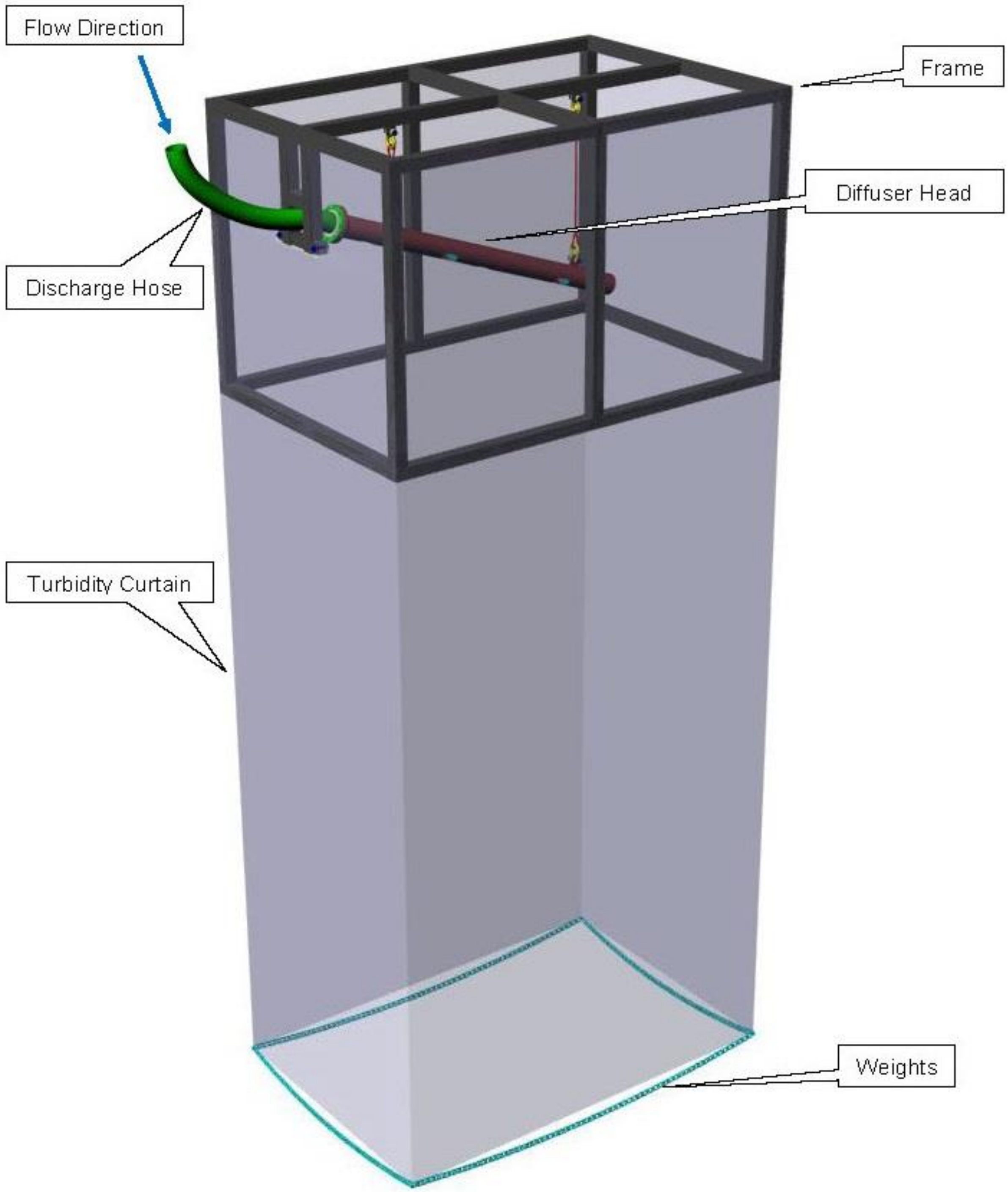
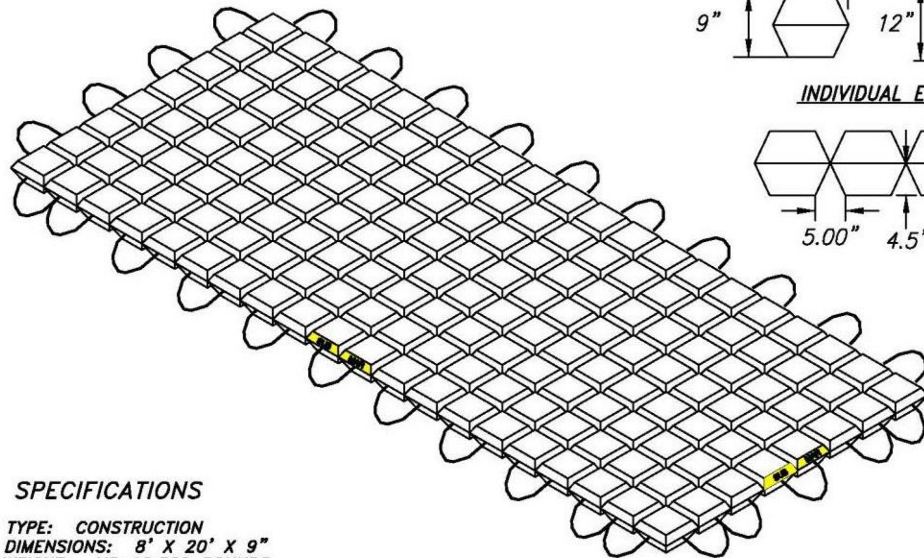
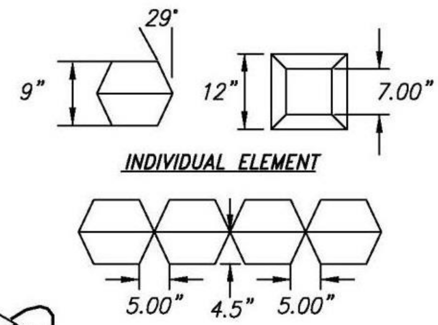


Figure 2.3.4-8
Diffuser Head and Turbidity Curtains
Aguirre Offshore GasPort Project





SPECIFICATIONS

MATTRESS TYPE: CONSTRUCTION
MATTRESS DIMENSIONS: 8' X 20' X 9"
MATTRESS WEIGHT: AIR 10,500 POUNDS
MATTRESS WEIGHT SUBMERGED: 6,000 POUNDS (APPROX.)
CONCRETE DENSITY: 145 LBS. PER CU. FT., 4,000 PSI
160 ELEMENTS: 5/8" ULTRA VIOLET STABILIZED COPOLYMER
EXTRUDED FIBER ROPE, MINIMUM TENSILE STRENGTH 9,500 POUNDS

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Houma, LA 70360
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SUBMAR
STANDARD 8.00'x20.00'
MAT DETAIL

9" CONCRETE MATTRESS

DATE:	CHECKED BY:	DRAWN BY:	SCALE:	CONTACT:	PHONE #:
01/03/13	DWD	KPF	N.T.S.		

Figure 2.3.4-9
Submar Concrete Mat Typical Drawing
Aguirre Offshore GasPort Project

Hydrostatic Testing

Prior to the final tie-ins with the FSRU and the Aguirre Plant, the entire pipeline would be hydrostatically tested in accordance with 49 CFR 192 and applicable permit conditions, to ensure that the system is free from leaks and provides the required margin of safety at operating pressures.

The hydrostatic testing would involve filling the pipeline with seawater using portable, high-volume pumps located on the lay barge. The intake rate would be dependent upon the speed of the pipe pig [1] used in the test, which would range between 1.5 to 3 feet (0.5 to 1 m) per second. The water intake would be fitted with a 100-micron screen to minimize intake of organisms. About 240,000 gallons (909 m^3) of water would be required to fill the pipeline and complete one full hydrostatic test. During the test, the water within the pipeline would be pressurized and monitored for consistent pressure over an 8-hour period. Aguirre LLC does not anticipate the need for more than one full test, although some water replenishment may be required if isolated connections or flanges need depressurizing and retightening.

2.3.5 Restoration

Following construction, the marine vessels would depart. Aguirre LLC would monitor the buried pipeline for the life of the Project to ensure pipe burial depth is maintained. Because the pipeline would be buried to natural grade or with 3 feet (1 m) of cover in Jobos Bay, Aguirre LLC would implement measures, developed in consultation with appropriate agency staff, to restore areas temporarily disturbed by construction activities. Seagrass beds, which are prevalent between PI 3 and PI 4, would be disturbed during construction. However, we anticipate that, through the natural spread of seed and rhizomes, the seagrass would reestablish itself over the pipeline. Aguirre LLC would implement its proposed Benthic Resources Mitigation Plan to ensure recovery in this area. Potential impacts on sensitive resources and Aguirre LLC's proposed mitigation measures are discussed in section 4.0.

2.4 CONSTRUCTION SCHEDULE AND WORKFORCE

Aguirre LLC anticipates that construction of the Project facilities would take approximately 12 months and would begin when all the necessary permits and regulatory approvals have been received. The estimated duration of the major construction activities is summarized in table 2.4-1. Aguirre stated that the final selection of the specific FSRU from the Excelerate Energy fleet would be made after issuance of the FERC authorization.

TABLE 2.4-1

Construction Schedule for the Aguirre Offshore GasPort Project

Project Component	Duration [a]
Offshore GasPort	
Marine Infrastructure [b]	9 months
Topside Facilities	8 months
Subsea Pipeline [c]	3 months

[a] Durations would be overlapping; total duration of the Project is estimated to be 12 months.
[b] Includes support infrastructure and platform decking.
[c] Includes 15 to 20 days for each of the pipeline segments.

[1] A pipeline "pig" is a devise used to clean or inspect the pipeline.

Aguirre LLC anticipates that approximately 350 workers would be required over the 12-month construction period. Aguirre LLC has committed to hiring locally at least 10 percent of its construction workforce. (see section 4.8.12).

2.5 ENVIRONMENTAL COMPLIANCE, INSPECTION, AND MONITORING

Aguirre LLC would conduct all Project activities in accordance with applicable federal, commonwealth, and local regulations, permits, and approvals. Aguirre LLC would employ an Environmental Inspector (EI) to ensure that the measures contained in the FERC *Upland Erosion Control, Revegetation, and Maintenance Plan* (Plan) and *Wetland and Waterbody Construction and Mitigation Procedures* (Procedures); Aguirre LLC's Project-specific plans; and any other environmental permit conditions or agreements are followed during construction and restoration activities. The EI would have authority to stop construction activities that violate the measures set forth in the Project documents and authorizations, as well as authority to order corrective actions.

Aguirre LLC would develop and implement an environmental training program tailored to the Project and its requirements. The program would be designed to ensure that:

- qualified environmental staff would provide focused training sessions to all personnel before they begin work;
- adequate training records would be maintained; and
- refresher training would be provided as needed to maintain high awareness of environmental requirements.

All personnel would receive special marine mammals observation and awareness training prior to conducting any on-water activities. In addition, NOAA-certified marine mammal observers would be present on all construction vessels for the duration of the construction activities.

2.6 OPERATION AND MAINTENANCE PROCEDURES

Operation of the Project would involve receiving LNG at the Offshore GasPort from LNG carriers, transferring the LNG to the FSRU for temporary storage, and regasification of the LNG for delivery as natural gas through the subsea pipeline to the existing Aguirre Plant. Operation of the Project facilities would be supported by a land-based office and an existing dock at the Aguirre Plant (see figure 2.2-2).

A port service vessel (PSV) would transport personnel to the Offshore GasPort. The PSVs would also assist with routine operations and the delivery of supplies. The PSVs would range in length from 110 to 125 feet (34 to 38 m) with a deck load of about 30 tons (27,200 kg) and a passenger load of approximately 30 to 40 personnel. In addition to the PSV, personnel may be transported via smaller vessels (25 to 30 feet [8 to 9 m] in length). PSV and other watercraft would provide transportation on a daily basis during routine operations.

Nitrogen would be required at the Offshore GasPort to purge the facility in preparation for maintenance or startup after a lengthy shutdown. A nitrogen generator sufficient to sustain normal offshore operations would be included on the platform. Gas/diesel-fueled generators on the platform would generate electric power for the Offshore Gasport. The platform would also include switchgear, transformers, and motor control centers as needed to distribute power throughout the facility. The electrical equipment would be housed in a climate-controlled switch room.

2.6.1 LNG Carriers

LNG would be transferred from the LNG carrier to storage tanks in the FSRU via unloading arms and cryogenic piping on the topside of the platform. LNG transfer from the LNG carrier would involve cooling of the loading arms and liquid LNG pipes located on the topside of the Offshore GasPort. During transfer, some LNG vapor would accumulate within the LNG storage tanks as a result of changes in heat and pressure and through displacement from the carrier as LNG is loaded into the FSRU. The vapor-handling system would collect the natural gas and direct it back to the LNG carrier, to the process heaters for use as fuel, or to the recondenser that would re-liquefy the vapor and send it to the storage tanks on the FSRU. Transfer of LNG from the LNG carrier to the FSRU would take approximately 72 hours to complete.

During transfer, the LNG carriers would take on ballast seawater to maintain constant draft. No imported ballast water would be discharged during any phase of the overall operation. The LNG carriers would be subject to USCG and Port State requirements and would comply with standards for ballast water exchange established by the International Marine Organization (IMO) (IMO, 2004).

While docked, the LNG carriers would require seawater for cooling the engines that generate electrical power for the offloading pumps and other onboard systems. An LNG carrier's engines are powered up while at dock; therefore, the cooling water needed during the entire time each LNG carrier is at the Offshore GasPort is estimated to be up to approximately 88 hours per carrier. Seawater would be used as a source for the cooling water. Seawater use during operation of the Project facilities is discussed in section 4.3.1.3.

2.6.2 Floating Storage and Regasification Unit

LNG would be transferred from the FSRU storage tanks by submersible pumps to vaporizers on the offshore berthing platform. Following revaporization, the natural gas would flow to shore via the subsea pipeline using the high-pressure gas manifold and loading arms. A schematic drawing of a high pressure gas loading arm is shown on figure 2.6.2-1. The loading arms would be in a stowed position on the platform without internal pressure when not in use. A hydraulic power system would be used to move, connect, or disconnect the loading arms during operation.

Once operational, the loading arms connected to the FSRU would be monitored by potentiometers. The loading arm position would be tracked both via a monitoring system located in the control room on the offshore berthing platform and a communications link on the FSRU. Independent proximity switches would monitor the position of the arm against predefined operating limits and these would initiate sequential safety actions in the event that the position of the arm exceeds the operating limits.

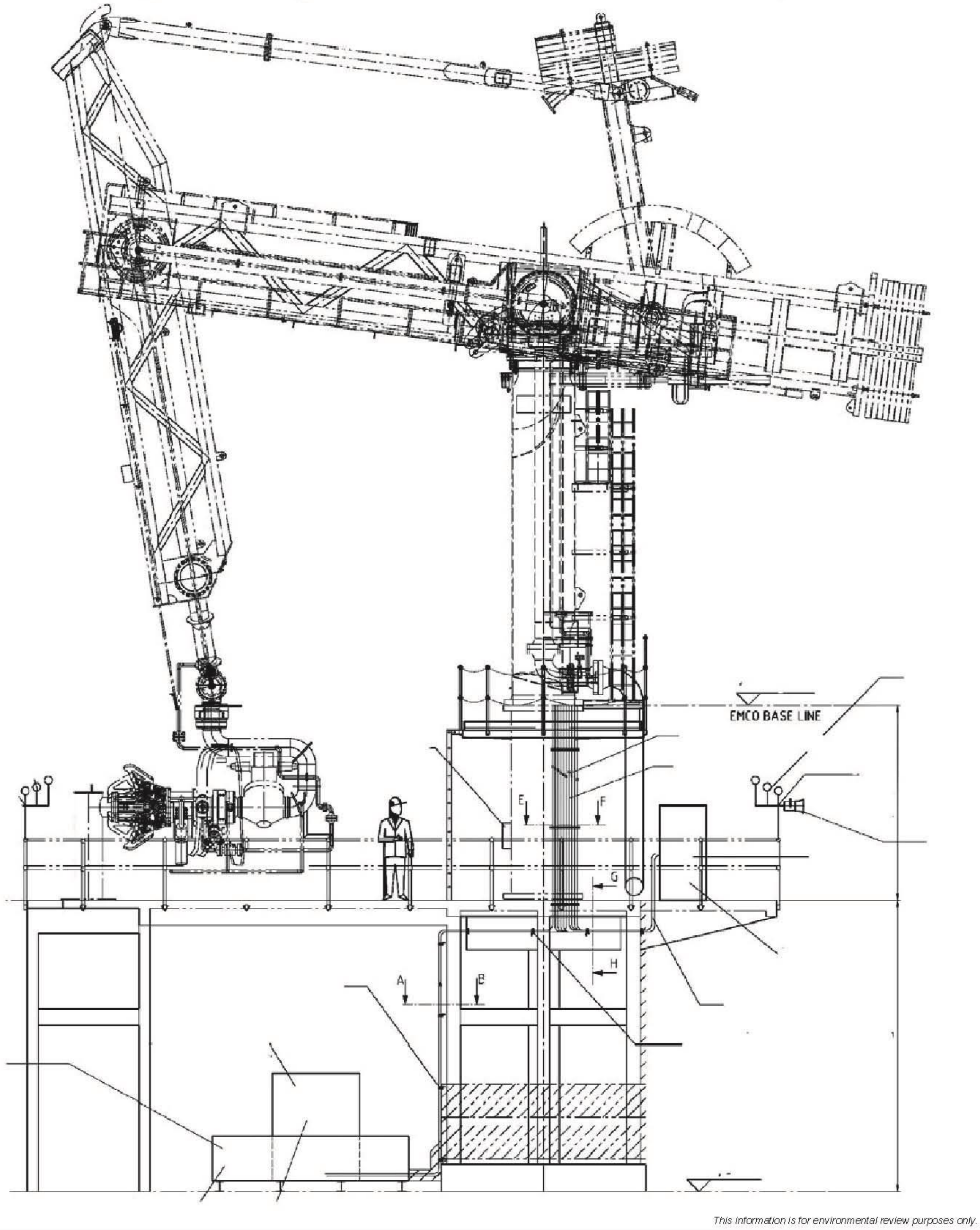

Figure 2.6.2-1
Schematic Drawing of High Pressure Gas Loading Arm
Aguirre Offshore GasPort Project

Regasification would be accomplished with a closed-loop vaporization system, which would not require the intake and discharge of seawater. The LNG regasification process is discussed in section 2.6.3. However, other routine operations would require seawater use, whether the FSRU was in standby mode or vaporization mode. These operations would involve maintenance of the vessel's main and auxiliary cooling systems, regulation of ballast water, provision of a safety water curtain during LNG transfer and regasification, maintenance of a desalination system to provide freshwater for hoteling and sanitary purposes, and maintenance of a marine growth preventative system. Seawater use during operation of the Project facilities is discussed in section 4.3.1.3

The FSRU would be subject to USCG 46 Chapter I, CFR Subchapter O Endorsement and Port State inspections for foreign flag vessels operating in U.S. waters. The USCG would conduct inspections of the FSRU. Scheduled maintenance of the FSRU would involve periodic service outages. During these outages, maintenance, and repairs on the main boilers and auxiliary and regasification systems would take place in order to maintain vessel class certificates. The FSRU would undergo dry-dock maintenance about every 5 years. During scheduled dry-dock periods, PREPA may require Aguirre LLC to use a similar FSRU to meet contractual send-out rates.

2.6.3 LNG Regasification Process

The LNG offloaded from the carriers would be stored in the cargo tanks on the FSRU at a pressure slightly above atmospheric. The LNG would then be pumped by low-pressure feed pumps to a suction drum that would serve as an accumulator and surge vessel for the high-pressure LNG pumps. Two small high-pressure pumps, each with a capacity of approximately 10 MMscf/d, would be used to increase the liquid pressure of the LNG gradually during start up to avoid the generation of excessive boil-off gas. Once a regasification flow rate of 10 MMscf/d has been achieved, the LNG vaporizer outlet control valves would be set to control the vaporization process at a pressure of at least 1,088 psi (7,501 kPa). A single high-pressure pump would increase the LNG flow rate to the minimum operating flow rate of 50 MMscf/d, which could then be increased up to 100 MMscf/d with an additional pump.

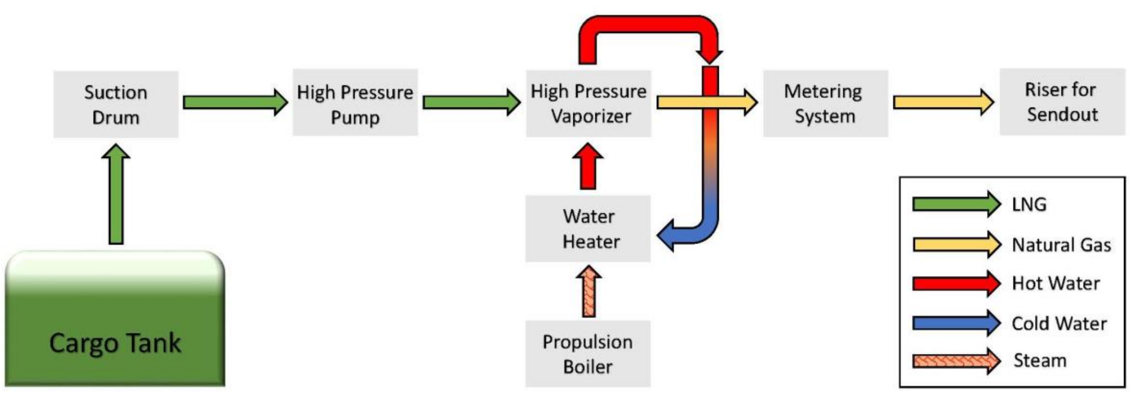

Figure 2.6.3-1 FSRU LNG Regasification Process

The FSRU would be equipped with six 100 MMscf/d capacity high-pressure pumps that would be used to send the cold LNG (approximately −260 degrees Fahrenheit [°F] [−162 degrees Celsius (°C)]) to the LNG vaporizers. The LNG vaporizers would consist of shell-and-tube heat exchangers that would use the vessel's internal heating system (closed-loop mode) to vaporize to natural gas and heat it to approximately 39 °F (4 °C). These units would be designed for a nominal delivery rate of 50 MMscf/d and a peak send-out rate of 600 MMscf/d when six vaporizers and high-pressure pumps are operating. This variability in send-out rate would allow for the Aguirre Plant to receive the 225 MMscf/d it can utilize. The natural gas leaving the LNG vaporizers would pass through a regulating station to ensure that the operating pressure of the gas flowing to the loading arm is maintained.

2.6.4 Subsea Pipeline Facilities

During commissioning, Aguirre LLC would purge the subsea pipeline of low pressure nitrogen, vented to the atmosphere at the Aguirre Plant, and fill it with natural gas from the offshore facilities. Once operational, the subsea pipeline would operate at a maximum allowable operating pressure of 1,450 psi (9,997 kPa). Normal sustained delivery capacity would be approximately 500 MMscf/d, with peak delivery up to 600 MMscf/d of natural gas. Facilities associated with the pipeline would include metering and pressure monitoring instrumentation.

Pipeline operation monitoring includes measuring discharge rate and pressure and would be handled from the continuously manned FSRU. Supervisory Control and Data Acquisition systems would be employed to monitor operations. The subsea pipeline would be equipped with automatic and manual shutdown systems that would be activated in the event of a pipeline leak or equipment failure. Pipeline maintenance would include regularly scheduled activities including pigging at intervals specified in Aguirre LLC's operations plans, which would be based on regulatory requirements of PREPA and the DOT, as conditions dictate.

On December 31, 2014, Aguirre LLC filed a draft Operations and Maintenance Manual (O&M Manual) and further committed to providing the final O&M Manual as part of further design. Aguirre LLC stated its operations would be in accordance with all applicable requirements in 49 CFR 192 that apply to its facility and the offshore natural gas pipelines. The following is a brief summary of the procedures that would be in place for the Project:

- making construction records and maps available to the appropriate operating personnel for the safe operation and maintenance of the pipeline;
- generating startup and shutdown procedures to ensure operation within the maximum allowable operating pressure (MAOP) limits of the pipeline;
- reviewing periodically any work done by operating personnel to determine the effectiveness of the procedures used in normal operation and maintenance;
- inspecting, including bottom survey, to observe surface conditions on and adjacent to the full pipeline right-of-way for indications of leaks, construction activity, and other factors affecting safety and operation; to be performed by a diver at an interval of 15 months, but at least once each calendar year;
- conducting a bottom survey to ensure pipeline integrity as soon as conditions are safe, after a named hurricane or named tropical storm within the area that could affect the pipeline integrity from a public/personnel safety or an environmental standpoint, and
- reassessing (inspecting) the pipeline at intervals with a tool or tools capable of detecting corrosion and deformation anomalies including dents, gouges, and grooves.

In the event that the pipeline has been determined to be non-compliant during inspection, necessary measures would be taken to return the pipeline to compliance per 49 CFR 192–199.

2.7 SAFETY CONTROLS

The Project could pose potential hazards during operation affecting public safety and port function. Primary concerns involve events or incidents that could lead to either an accidental or intentional release of LNG from Offshore GasPort creating a hazard. Consequences from a release could include cryogenic structural damage, burns, asphyxiation, mechanical damage, and fire. The Offshore GasPort would be approximately 3 miles (5 km) offshore from the Aguirre Plant in water at least 60 feet (18 m) in depth. Minimal impacts on land-based infrastructure and communities would be expected in the event of an LNG-related accident. All facilities would be subject to stringent design, construction, operation, and maintenance requirements. Aguirre LLC would follow extensive safety procedures and employ systems to monitor, detect, and control potential hazards. Safety controls for the Project are described below.

2.7.1 Offshore GasPort

The Offshore GasPort would include fire and gas detection systems that would alert personnel in the event of an emergency. These systems would be automated, warning personnel and allowing emergency contingency procedures to be implemented. An Emergency Shut Down (ESD) system would have redundancy to ensure response reliability in the event of a safety-related upset condition. The offshore berthing platform ESD system would be linked to the FSRU ESD system via ship-to-shore communication links.

Fire protection for the offshore facility would conform to standards established by the National Fire Protection Association (NFPA) 59A Standard for the Production, Storage, and Handling of LNG. Components of fire protection include:

- gas and fire detection instruments;
- wet ring-main system;
- ESD system;
- main and auxiliary fire pumps;
- oscillating monitors for deluge of the FSRU and offshore berthing platform equipment;
- water spray rails for the loading arms and gangways;
- hydrants and IMO ship connections;
- water curtain systems for personnel escape protection;
- deckwash under cold drain tanks for dispersion of LNG drips; and
- deckwash for protection of LNG loading manifold and decks and side shells.

The FSRU would be subject to USCG 46 CFR Chapter I, Subchapter O Endorsement and Port State inspections.

2.7.1.1 Spill Impoundment System

The FSRU LNG tanks would be double-containment tanks, with a complete inner tank inside of a complete outer tank. The tanks would be designed in accordance with the IMO's International Gas Carrier Code.

Ships, including the FSRUs, are required by the International Convention for Prevention of Pollution from Ships (MARPOL) to maintain a Shipboard Oil Pollution Emergency Plan (SOPEP). Regulation 26 of Annex I of MARPOL 73/78 requires that oil tankers of 150 gross tonnage or more and all ships of 400 gross tonnage or more carry an approved SOPEP (IMO, 1983). SOPEPs contain measures and plans for responding to and mitigating the effects of a pollution incident originating with a vessel. The plans include contact information for emergency response organizations to respond to a pollution incident.

Vessels calling in the United States are required to have contracted the services of a response organization to provide first response capabilities in the event of a spill within U.S. waters. These plans must be reviewed and approved by the vessel's flag administration, and would be regularly checked by USCG Marine Inspection personnel. The FSRU, as well as LNG carriers calling on the Offshore GasPort would maintain SOPEPs. The FSRU would also maintain a Certificate of Financial Responsibility in accordance with the Oil Pollution Act of 1990.

2.7.1.2 Fire and Hazard Detection and Control Systems

The FSRU would be fitted with a variety of fire prevention, detection, and extinguishment tools. The vessel would meet the requirements for an LNG carrier in firefighting respects as set forth in the International Convention for the Safety of Life at Sea (SOLAS) (IMO, 1974). The equipment and systems installed would be those approved for the vessel's classification society and strategically placed for rapid deployment and use and regularly inspected for operational readiness. Aguirre LLC would maintain the systems and equipment in accordance with a planned maintenance system that would be documented and open to records inspection in the vessel's Safety Management System.

The FSRU and offshore berthing platform personnel would receive marine and LNG-specific fire-fighting instruction from internationally accredited firefighting schools. The personnel would use a variety of tools, agents, and techniques to prevent, detect, and extinguish fire, and to mitigate damage as required, while protecting the environment external to the vessel.

Marine Firefighting and Salvage requirements under 33 CFR 155 regulate vessels carrying oil. The offshore berthing platform would follow regulations pertinent to firefighting and emergency response for LNG facilities, 33 CFR 127. Aguirre LLC would develop a Project-specific Emergency Response Plan (ERP) for approval by FERC prior to any site construction. Aguirre LLC would consult with the USCG and other Commonwealth and local agencies, as needed, during preparation of the ERP. The ERP would address marine firefighting and response at the offshore berthing platform. The Emergency Procedures Manual would address marine firefighting response, as well as oil spill response as it relates to bunkers, minor spills resulting from hydraulic lines, or other auxiliary equipment at the facility.

The firefighting medium would be seawater. As this represents an essentially infinite water source, no backup system would be needed. The offshore berthing platform would house some oil spill response equipment, including but not limited to, empty drums, buckets, absorbent sheets, plastic drums, and protective gloves.

2.7.1.3 Emergency Shutdown System

An extensive manually and/or automatically activated ESD system and automatically activated Automatic Shut Down (ASD) system would deactivate LNG regasification and natural gas transfer in the event of any malfunction. The primary difference between the two systems is that the ESD system is intended to work to quickly stop cargo transfer during an emergency condition and cause primary isolation or ESD valves to automatically close, terminating the transfer of cargo. The ASD system is designed to prevent mechanical damages to equipment and further problems by eliminating the potential for a hazardous condition to exist. At any time during gas transfer operations that an ASD or ESD occurs, the Vessel Operator's Person in Charge (PIC) would confirm the shutdown to the Offshore Berthing Facility Operator. Following an ASD or ESD function, the Vessel Operator must demonstrate to the PIC that the cause of the shutdown has been rectified, and must receive permission from the PIC to resume gas discharge operations

The ESD system can be initiated manually by operating personnel from several ESD stations around the FSRU. Manual ESD switches would be located in four locations aboard the vessel that control

ESD valves on the FSRU and on the offshore berthing platform. The Vessel Operator would control the valves connecting the FSRU and natural gas pipeline system. Detection equipment aboard the FSRU would include state-of-the-art gas, fire, and smoke detection systems that continually monitor the atmosphere of the FSRU.

In addition to the manual operation described above, the ESD would be activated when any automated permissive control sensors indicate a non-standard situation, including (but not limited to) detection of hydrocarbon gas vapor at 60 percent lower explosive limit, or detection of fire.

2.7.2 Pipeline Facilities

PHMSA's "Minimum Federal Safety Standards" for natural gas pipelines as contained in 49 CFR 192 prescribe the minimum standards for operating and maintaining pipeline facilities, including the requirement to establish a written plan governing these activities. Under 49 CFR 192.615, each pipeline operator must also establish an Emergency Plan that provides written procedures to minimize hazards from a gas pipeline emergency. Key elements of the Emergency Plan would include procedures for:

- receiving, identifying, and classifying notices of events that require immediate response by the operator;
- establishing and maintaining communications with appropriate fire, police, and public officials;
- prompt and effective response to a notice of each type of emergency, including:
  - gas detected inside or near a building;
  - fire located near or directly involving a pipeline facility;
  - explosion occurring near or directly involving a pipeline facility; or
  - natural disaster;
- making personnel, equipment, tools, and materials available at the scene of an emergency;
- protecting people first and then property, and making safe any actual or potential hazards to life or property;
- emergency shut down and pressure reduction in any section of the system necessary to minimize hazards to life or property;
- notifying appropriate fire, police, and other public officials of gas pipeline emergencies and coordinating with them both planned responses and actual responses during an emergency;
- investigating any failures;
- establishing procedures for actions to be taken by a controller during an emergency in accordance with § 192.631; and
- safely restoring any service outage.

Each operator must train appropriate operating personnel to ensure that they are knowledgeable of the emergency procedures and verify that the training is effective. Following any emergency, the operator must review employee activities to determine whether the procedures were effectively followed.

Each operator must establish and maintain liaison with appropriate fire, police, and public officials to identify the resources and responsibilities of each organization that may respond to a gas pipeline emergency and to coordinate mutual assistance in responding to emergencies. The operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to appropriate public officials.

An Emergency Plan as required by 49 CFR 192 for the subsea pipeline component would be incorporated into Aguirre LLC's ERP.

2.8 FUTURE PLANS AND ABANDONMENT

Aguirre LLC has not identified any plans for the future expansion or abandonment of the Project facilities. We received several comments related to the volumes of LNG that would be delivered to the LNG terminal being in excess of what the Aguirre Plant can consume. Aguirre LLC contends that extra volume of LNG is necessary to maintain sufficient fuel storage for the Aguirre Plant. Aguirre LLC also stated that Excelerate's EBRVs, one of which would be used for the FSRU, must be adequately sized to be useful in various different projects and that the ability to lower the send-out rate to 50 MMscf/d would allow the Aguirre Plant to receive only the amount of natural gas it is capable of using. Both Aguirre LLC and PREPA assert that the sole purpose of the Project is to supply natural gas to the Aguirre Plant.

The EPA also asserted its concern over the additional capacity on the FSRU and the possibility for transportation of the gas to other facilities in Puerto Rico. On November 5, 2013, the EPA requested further information on the additional capacity in response to PREPA's PSD Non-Applicability Analysis application to EPA. Following PREPA's response to the EPA's concerns, the EPA issued its finding on May 6, 2014, that the Aguirre Power Plant and the proposed Project would not be subject to PSD requirements provided that certain permit conditions would be included in the EQB construction permits for both the Aguirre Plant and the Project. These conditions regarding the available capacity on the FSRU included, but are not limited to the following:

- PREPA shall own and shall have all the necessary rights to utilize the 4.0 miles (6.4 km) of pipeline and the Offshore GasPort facility;
- the contract agreements between PREPA and Excelerate Energy shall give PREPA exclusive rights to 100 percent of the LNG at the Offshore GasPort; and
- any proposed change to transfer the natural gas from the Offshore GasPort to another entity other than the PREPA Aguirre Plant shall be presented to EPA for review to determine whether the single source determination is still valid.

These conditions in the EPA's finding thereby prohibit the use of the additional gas capacity at any other facility other than the Aguirre Plant without additional permitting and review.

If the Project facilities are proposed to be expanded to provide natural gas service to other facilities, appropriate federal, state, and local regulations would need to be complied with by Aguirre LLC. Similarly, if the Project facilities are abandoned in the future, Aguirre LLC would need to comply with the appropriate federal, state, and local regulations in effect at that time (including the FERC's abandonment regulations).

3.0 ALTERNATIVES

In accordance with NEPA and Commission policy, we evaluated alternatives to the Aguirre Offshore GasPort Project to determine whether they would be reasonable and have significant environmental advantages compared to the proposed action. NEPA requires that federal agencies evaluate reasonable alternatives to a proposed major federal action. According to CEQ, "reasonable alternatives include those that are practical or feasible from the technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant" (CEQ, 1981). Further, the FERC has established several key criteria to evaluate potential alternatives identified for a given project. Each alternative is thus evaluated in consideration of whether it would:

- be technically and economically feasible and practical;
- offer significant environmental advantage over the proposed project; and
- meet the proposed project objectives.

With respect to the first criterion, not all conceivable alternatives are technically feasible and practical. For example, some alternatives may not be possible to implement due to technological difficulties or logistics. For the second criterion, in conducting an alternatives analysis, the environmental advantages and disadvantages of the proposed action must be recognized in order to focus the analysis on reasonable alternatives that may reduce impacts and offer a significant environmental advantage. Finally, an alternative must at a minimum meet the proposed project objectives.

Specific to the Aguirre Offshore GasPort Project, the purpose of our alternatives evaluation was to determine whether there are reasonable alternatives that would result in less environmental impact than the Project as proposed while still meeting the Project's objectives. As described in section 1.1, Aguirre LLC indicated the following Project objectives:

- diversify the energy sources at the Aguirre Plant, thereby reducing the use of fuel oils, as outlined in PREPA's Corporate Strategic Plan 2011–2015;

- allow the Aguirre Plant to meet the requirements of the EPA's MATS rule;

- reduce fuel oil barge traffic in Jobos Bay, thereby reducing the potential for fuel spills, as well as potential encounters with certain endangered species and recreational boat traffic; and

- contribute to price stabilization.

The range of alternatives to the proposed action that are addressed in this section include the No-Action Alternative, System Alternatives, Terminal Site Alternatives, Pipeline Route Alternatives, Pipeline Route Variations, and Vaporization Alternatives.

As part of the No-Action Alternative, we considered the effects and actions that might result if the proposed Project were not constructed. We identified system alternatives to evaluate the ability of existing LNG import terminals and pipeline systems to meet Aguirre LLC's objectives. We also evaluated alternative locations for the Offshore GasPort and the offshore pipeline.

Aguirre LLC participated in our pre-filing process for the Project (see section 1.3), as well as provided additional information on potential alternatives, following the submittal of its application, in response to concerns from federal and state agencies regarding the proposed pipeline route. This process emphasized identification of potential stakeholder issues, as well as the identification and evaluation of alternatives that could avoid or minimize impacts. We analyzed each alternative based on public comments; guidance received from federal, state, and local regulatory agencies; and our own independent investigations. Using the evaluation criteria discussed above and subsequent environmental comparisons, each alternative was considered to the point where it was clear that the alternative was either not reasonable, would result in substantially greater environmental impacts that could not be readily mitigated, offered no potential environmental advantages over the proposed Project, or could not meet the Project's objectives. Alternatives that resulted in less than or similar levels of environmental impact were reviewed in greater detail. The following sections discuss and analyze the alternatives evaluated.

3.1 NO-ACTION ALTERNATIVE

The action triggering this environmental review was Aguirre LLC's application to the FERC. If the No-Action Alternative is selected by the Commission denying the proposal, the proposed facilities would not be constructed and the short- and long-term environmental impacts would not occur. In addition, if the No-Action Alternative were selected, the stated objectives of Aguirre LLC's proposal would not be met.

The No-Action Alternative would eliminate this new long-term natural gas supply source for Puerto Rico causing the Aguirre Plant to continue to burn fuel oil. The Project objectives of diversifying the plant's fuel sources and meeting the requirements of the EPA's MATS rule would also not be achieved. The continued use of fuel oil as a resource would cause Aguirre LLC to operate in violation of the EPA mandate and it could prolong the community's exposure to emissions from the operation of the plant. In addition, the lack of a new fuel source for the plant would require the continued weekly delivery of fuel oil by barges, thus maintaining the risk of a potential fuel oil spill.

Aguirre LLC states that the construction of the terminal and pipeline is necessary to satisfy the EPA's MATS rule requirements to reduce emissions (e.g., by replacing the fuel source). Puerto Rico continues to need the electrical power that is provided by the Aguirre Plant. With the limitation of increased use of fuel oil, natural gas is a reasonable alternative for Puerto Rico to consider when reviewing options to improve the Aguirre Plant's emissions. Several natural gas pipelines have been proposed to bring natural gas to the Aguirre Plant but due to Puerto Rico's sensitive environmental resources and other factors, these proposals have failed.

If the Commission denies this authorization, the environmental impacts identified in this final EIS for the Project would not occur, but the additional supply of natural gas to meet the demand would not be available, and the diversity of fuel supply for the Aguirre Plant would not be introduced. The continued use of diesel fuel as opposed to natural gas could result in continued exposure to air pollutant emissions from diesel fuel. The No-Action Alternative would not be preferable to or provide a significant environmental advantage over the Project and would not comply with the EPA's MATS rule requirements.

3.2 ENERGY ALTERNATIVES

We believe it is important to consider alternative energy sources as part of the alternative selection process. As noted above, implementing the No-Action Alternative could force Puerto Rico to seek other forms of energy. Traditional energy alternatives to natural gas include coal and hydroelectric. Renewable energy resources such as solar, ocean energy, biomass, wind, landfill gas, and municipal solid waste represent new, advanced energy alternatives. In 2012, 65 percent of Puerto Rico's electricity came from petroleum (including diesel fuel), 18 percent from natural gas, 16 percent from coal, and 1 percent from renewable energy. Puerto Rico has enacted a Renewable Energy Portfolio Standard requiring PREPA to generate 12 percent of its electricity from renewable sources starting in 2015, scaling up to 15 percent by 2020 and 20 percent by 2035.

Because the renewable energy sector is demonstrating its capacity to deliver cost reductions, the sector is expanding rapidly. Costs have been decreasing around renewable energies and a portfolio of renewable energy technologies is considered to be cost-competitive (International Energy Agency, 2014). As reported by the U.S. Energy Information Administration (DOE/EIA), renewable consumption will grow by about 0.7 percent in 2014 (for electricity and heat generation use). In the DOE/EIA (2014) short-term energy outlook it found by "2015, renewables consumption for electric power and heat generation is projected to increase by a rate of 5.8 percent from 2014, as a 5.0 percent increase in hydropower is combined with a 6.2 percent increase in non-hydropower renewables." However, economic barriers that would prevent further expansion and costs would need to be reduced further to promote growth over the next decade.

Energy Conservation Measures: Energy conservation measures have and will likely continue to play an important role in reducing energy demand in the United States. At the federal level, for example, the Energy Policy Act of 2005 (EPAct)contained provisions for diversifying America's energy supply, reducing dependence on foreign sources of energy, increasing residential and business energy efficiency and conservation, improving vehicular energy efficiency, and modernizing domestic energy infrastructure. EPAct additionally directed the U.S. Secretary of Energy to conduct research and develop programs for energy efficient commercial applications (U.S. Congress, 2005).

EPAct and other federal programs collectively promote increased energy efficiency and conservation by supporting new technologies and increasing funds for research and conservation. However, while these initiatives may minimize energy use, they are not expected to eliminate the demand for natural gas in the Project area. The implementation and success of energy conservation and efficiency programs in curtailing energy use is a long-term goal requiring large-scale public education efforts, significant incentives, and government intervention extending well beyond the timeframe of the proposed Project. We note that the government of Puerto Rico and many of its citizens recognize energy conservation as one component of a larger portfolio of solutions, including increased use of natural gas, to provide clean, secure, reliable, and less expensive energy. Therefore, while energy conservation and efficiency would reduce demand for new energy supplies to some degree, we conclude it would not eliminate the need for the natural gas supply to the Aguirre Plant in the nearterm.

Coal: The International Energy Agency (2014) reported that coal exports are increasing, and in the United States several new coal export projects were recently proposed, suggesting that in many international markets coal will remain competitive with natural gas in spite of coal's greater air emissions. The EPA (2013) states that compared to the average air emissions from coal-fired generation, natural gas power plants produces half as much carbon dioxide (CO_2), less than a third as much nitrogen oxides, and one percent as much sulfur oxides. As a result, if the No-Action Alternative is selected, PREPA could opt for the use of coal; however, due to the MATS rule standards, PREPA would have to implement significant air emissions control equipment at the Aguirre Plant which would make coal as a fuel source less attractive. For these reasons, coal is not a reasonable alternative to the Project.

Solar: In the DOE/EIA's short-term energy outlook report, solar electricity generation is expected to continue to grow; however, it is estimated it will only represent 0.4 percent of the total U.S. generation by 2015. While solar electricity generation is often generated for customer-sited distributed installations, the utility-scale solar capacity grew by 96 percent in 2013 (DOE/EIA, 2014). As of December 2014, Puerto Rico had four operating solar farms providing 113.1 MW of power. In addition, 2 more solar farms will come on line in 2015 providing an additional 30 MW of power. The closest solar farm to the Project site is AES Ilumina with a 20-MW solar farm in Guayama, about 4.5 miles (7.2 km) east of the Aguirre Plant. Electricity generated at the facility is sold to PREPA under a 20-year power purchase agreement. Salinas Solar Park is a 16-MW solar power plant in Salinas, about 2.5 miles (4.0 km) north of the Aguirre Plant. The solar-powered power plants can provide a certain amount of electricity to the area; however, these plants are not capable of providing the same capacity as the Aguirre

Plant. In the near term, there are no solar projects planned that have the capacity to replace the Aguirre Plant.

Like other renewable energy fuels, solar power may be able to replace some of the demand in the Project area. However, solar energy would not meet the objectives of the Project (e.g., met the MATS rule, reduce fuel oil barge traffic, and diversify energy resources.) Additionally, construction of commercial-scale solar facilities would require development of large sites and construction of new electric transmission facilities, which could result in impacts similar to or greater than those of the Project. For these reasons, solar energy would not would not be preferable to or provide a significant environmental advantage over the Project.

Tidal and Wave: Tidal and wave energy is a largely unexplored renewable resource. Technologies to capture ocean energy are in their infancy, and environmental and engineering considerations are being studied to better understand the implications of placement of power generating facilities (hydrokinetic facilities) in the ocean. Wave energy technology is in the early stages of development and is not commercially available. Additionally, the high cost of construction and potential for environmental impacts on marine resources may limit development of this resource for Puerto Rico. Like the other renewable fuels, tidal and wave energy may be able to replace some of the demand in the Project area. However, it is unlikely that the environmental impacts associated with construction and operation of large-scale hydrokinetic facilities, including any electric transmission lines needed to bring the power to market, would be significantly less than those of the Project. This is due to the potential construction and operational impacts on the marine environment associated with a permanent, large-scale hydrokinetic generating facility. For these reasons, tidal and wave energy would not be preferable to or provide a significant environmental advantage over the Project.

Biomass: In June 2013, the EPA granted an air permit for the construction and operation of a 77-MW solid waste facility in Puerto Rico located at the former site of the Global Fibers Paper Mill. In addition, the EQB issued its permit in October 2014. The project has not begun construction. In addition, PREPA is working to construct two small landfill gas plants: one in at Fajardo on the northeast coast and the other in Toa Baja west of San Juan on the northern coast. PREPA has been working with developers to develop biomass projects; however, many of the facilities have encountered community opposition. Biomass fuels used to generate electricity may be able to replace some of the demand in the Project area, but this would not meet the objectives of the Project. However, there currently is a lack of adequate infrastructure to convert biomass to power and transport the energy to market on a large scale. As a result, biomass fuels as a substitute for natural gas would require the construction of new facilities, including pipelines, which could result in impacts similar to or greater than those of the Project. For these reasons, the use of biomass energy would not be practical or provide a significant environmental advantage over the Project.

Wind: Wind power is a proven technology that has experienced significant advances in recent years, including reduced installation and maintenance costs and improved turbine performance. Currently, Puerto Rico has two wind farms. The Finca de Viento Santa Isabel wind farm, opened in late 2012, is composed of 44 wind turbines, each generating 2.3 MW, with a total capacity of 95 MW. This wind farm, the first utility-scale wind farm in Puerto Rico, is sited on approximately 5,500 acres (5,660 cuerdas) of Puerto Rico Land Authority-owned land southwest of the Project area. PREPA is buying 75 MW of the wind farms' output via long-term power purchase agreements. The second wind farm began operation in April 2013. This Punta de Lima Wind Farm is composed of thirteen 1.8-MW turbines with a total capacity of 23.4 MW. This wind farm is located on the southeast coast of the island approximately 50 miles (80 km) from the proposed Project. It is likely that wind projects will continue to be developed in Puerto Rico. In the long-term, wind energy may be able to replace some of the energy demand in Puerto Rico; however, in the short-term, sufficient wind energy is not available in the Project area that could provide the power of the Aguirre Plant. For these reasons, wind energy would not be preferable to or provide a significant environmental advantage over the Project.

With regard to these renewable sources of energy, natural gas is often considered a “bridge fuel;” a fuel that bridges the time between the dominant use of fossil fuels today and the greater use of renewable energy sources in the future. Natural gas is cleaner burning than other fossil fuels and can also reliably serve as a backup fuel to renewable energy facilities, which often provide power intermittently. There is currently considerable momentum behind advancing renewable energy technologies and moving toward more diversified energy sources. These advanced technologies, either individually or in combination, will likely be important in addressing future energy demands. Presumably, as renewable energy technologies continue to advance, they will offset an increasing amount of fossil fuels to meet growing energy demands.

While renewable energy projects have been and will be proposed in the Project area that will help diversify the electricity market and decrease the need for traditional fossil fuel energy sources, there still would be issues associated with the siting and development of renewable energy facilities. Other issues would include high costs and the time required to develop new energy infrastructure, including electricity generation and transmission facilities. Construction of new facilities would result in impacts on air, water, wildlife, and other resources, which could be similar to or greater than those for the proposed Project. Therefore, renewable energy alternatives were eliminated from further consideration.

3.3 SYSTEM ALTERNATIVES

The purpose of identifying and evaluating system alternatives was to determine whether potential environmental impacts associated with the construction and operation of the Project could be avoided or reduced. By definition, implementation of a system alternative would make it unnecessary to construct all or part of the proposed Project, although modifications or additions to the system alternative may be required to increase capacity or provide receipt and delivery capability consistent with that of the proposed Project. Such modifications or additions may result in environmental impacts less than, comparable to, or greater than those associated with construction and operation of the Aguirre Offshore GasPort Project.

We reviewed system alternatives to evaluate the ability of existing, modified, or proposed facilities to meet the stated objectives of the Project. A viable system alternative to the Project would have to provide the natural gas at the contracted volumes to operate the Aguirre Plant. A viable system alternative would need to provide these services within a timeframe reasonably similar to the Project while providing an environmental advantage over the proposed action. A brief assessment of each of the existing and proposed systems is provided below.

3.3.1 Existing EcoEléctrica LNG Facility, LNG Trucking Facility, and/or New Pipeline

In order for us to recommend a system alternative, the alternative must be technically and economically feasible. In addition, it must offer a significant environmental advantage over the Project. We reviewed a system alternative that included the expansion of the only LNG import terminal in Puerto Rico, the EcoEléctrica LNG (EcoEléctrica) facility in Peñuelas, with a trucking option or new pipeline option to supply gas to the Aguirre Plant. Figure 3.3.1-1 shows the footprint of the EcoEléctrica facility. EcoEléctrica is a FERC-regulated facility that began commercial operations in March 2000. It applied for its FERC Certificate in 1995 and received its authorization by the FERC under Section 3 of the NGA on May 15, 1996 in Docket No. CP95-35-000. Since its construction, it has operated 94 percent of the time, receiving ships from Trinidad and Tobago. EcoEléctrica can store approximately 1,000,000 barrels of LNG or a 40-day power supply to its current customers. EcoEléctrica is the only facility on the island with the capability to import, store, regasify, and export natural gas.

Figure 3.3.1-1
EcoEléctrica LNG Facility Footprint
Aguirre Offshore GasPort Project

In 2012, EcoEléctrica expanded the regasification capacity at its terminal to supply fuel to two nominal 400-MW conventional steam units at PREPA's Costa Sur Power Plant. This plant was retrofitted for dual fuel operation in 2011.

For the EcoEléctrica facility to be a viable system alternative to the proposed Project, the facility would have to construct new LNG storage capacity and regasification facilities as well as a new pipeline (discussed below) or trucking capacity to connect the EcoEléctrica facility to the Aguirre Plant. EcoEléctrica in its original FERC application was approved to construct two 1-million-barrel LNG storage tanks. The second LNG storage tank was not constructed and Commission authorization to construct this tank has since lapsed. Commentors on the draft EIS recommended that the EcoEléctrica plant construct the second tank as planned and construct a pipeline to the Aguirre Plant. At this time, EcoEléctrica has no plans to construct its second tank. If constructing a second tank were to be a viable alternative, it would have required EcoEléctrica to commence seeking approval in 2012 to meet the required schedule of the EPA MATS rule. To date, EcoEléctrica has not sought to gain approval of a second tank at its facility and therefore a second tank alternative is not a reasonable alternative.

On June 19, 2014, FERC issued an approval for the EcoEléctrica facility to amend its previous authorization under Section 3 of the NGA to construct and operate LNG supply pipelines (LNG Supply Project) to Gas Natural Fenosa's (a Spanish company and part owner of EcoEléctrica) proposed LNG Truck Loading Facility, which will be utilized to distribute LNG by truck to various industrial end users in Puerto Rico. The LNG Truck Loading Facility, which is not under the FERC's jurisdiction, would be located entirely outside of the EcoEléctrica property, adjacent to the entrance to the EcoEléctrica site on the north side of its property. The LNG Truck Loading Facility is designed to accommodate a maximum LNG flow rate of 250 gallons per minute (946 liters) at a delivery pressure of approximately 100 psi. The LNG Truck Loading Facility would include parallel truck-loading stations capable of simultaneously loading single, standard 12,000 gallons (45,425 liters) LNG trailers. Each loading station would be able to complete the loading process in approximately 1.5 to 2 hours.

The Truck Loading Facility does not have sufficient capacity to provide the necessary gas for the Aguirre Plant. The Aguirre Plant uses approximately 225 MMscf/d on an average day which, assuming that 1 gallon of LNG is approximately 82.6 standard cubic feet in a gaseous state, would require 227 truck deliveries to the facility each day. Trucking at this scale would require road improvements for the local roads (PR-7710 and PR-3). Completing improvements to the roads as well as requesting the LNG Truck Loading Facility to increase its capacity to such a size as to provide sufficient LNG to the Aguirre Plant is not a reasonable alternative to the proposed action.

Two previously planned pipeline projects in Puerto Rico were developed to assist in the diversification of fuels sources for Puerto Rico, as shown in figure 3.3.1-2. The first project, Gasoducto del Sur ("Southern Gas Pipeline"), PREPA proposed in 2008. This project, a 42-mile-long (68 km), 20-inch-diameter (51 cm) pipeline was designed to transport natural gas from the EcoEléctrica facility in Peñuelas to the Aguirre Plant. Construction of Gasoducto del Sur began in 2008; however, only 10 miles (16 km) were constructed prior to it being cancelled in 2009 due to significant public opposition. The project route crossed the highly populated southern coastal areas, as well as unique hydrographic basins and sensitive areas. We did receive a comment on the draft EIS from the NMFS reiterating its preference for a land-based alternative (additional facilities at EcoEléctrica and construction of onshore pipeline similar to Gasoducto del Sur) to avoid impacts on the marine environment. However, we cannot recommend the Gasoducto del Sur pipeline as an alternative to the Project because it does not appear to have the support of the Puerto Rico government or the public, and we have no indication that it will ever be constructed.

Figure 3.3.1-2
EcoEléctrica LNG Facility Location and New Pipeline Alternatives
Aguirre Offshore GasPort Project

The second project, the Via Verde Project ("Green Way Project"), proposed by PREPA in 2009 was to construct a natural gas pipeline from EcoEléctrica to the north. The Via Verde Pipeline was approximately 92 miles (148 km) long and extended northerly from EcoEléctrica to deliver natural gas to PREPA's Cambalache Power Station in Arecibo, Puerto Rico, continue easterly along the north coast of the island, and terminate at the Central San Juan Power Plant in San Juan, Puerto Rico. This project would supply natural gas to northern Puerto Rico, enabling a reduction of emissions at the northern power plants, which could help Puerto Rico meet its overall emissions goals. In October 2012, the application to the COE was withdrawn. The EPA and FWS had written letters to the COE recommending the project be denied its permit. We have no indication that this project is, or will ever be, viable or likely to be constructed. Even if the Via Verde Project is reinitiated, we do not find it to be a reasonable alternative because it does not meet the timing objective of the proposed action.

As the proposed Project does not require construction of onshore LNG storage facilities and additional gasification facilities, the expansion at the EcoEléctrica facility or expanding the LNG Truck Loading Facility and improving the necessary roads, would likely result in greater onshore environmental impacts than the proposed Project. In addition, reviving the failed Gasoducto del Sur (or start the permitting process over for a similar pipeline) is not a reasonable system alternative and was not considered further. The Via Verde Project would also not meet the objectives of the proposed Project and was not evaluated further. For the reasons discussed above, we concluded that the expansion of the existing EcoEléctrica facility (and trucking facility or associated pipeline) was not considered to be an environmentally preferable or feasible alternative to the proposed Project and was removed from further consideration.

3.4 FACILITY SITING ALTERNATIVES

We evaluated the area in the vicinity of the existing Aguirre Plant for alternative sites to the proposed Offshore GasPort. Each alternative site was evaluated in consideration of whether it would be technically and economically feasible and practical; offer significant environmental advantage over the proposed Project; and meet the proposed Project objectives. An alternative facility site would need to be in close proximity to the existing plant to allow the Project to obtain its objective of fuel conversion at this plant. Our evaluation of alternative sites considered two land based sites and two dockside sites. The LNG Terminal Site Alternatives considered are illustrated on figure 3.4-1 and summarized by type in table 3.4-1. Note that a dockside facility would require Aguirre LLC to moor a FSRU vessel that connects to a shore-mounted high-pressure gas unloading arm. The FSRU vessel would function similar to a land-based LNG receiving terminal; however its construction costs would be lower because of the use of an existing FSRU for LNG storage and regasification.

3.4.1 Las Mareas Bay

Las Mareas Bay is approximately 6.0 miles (9.7 km) east of the Aguirre Plant with access to the area off Puerto Rico Highway 3. Two industrial facilities are located on the north shore of Las Mareas Bay: the Chevron-Philips chemical facility and the AES Puerto Rico, L.P. (AES) 454-MW coal-fired power generation facility. The Chevron-Philips facility was sold in 2008 with the intent to dismantle and salvage the assets. An existing pier associated with the Chevron-Philips facility remains and extends into Las Mareas Bay. The AES facility was the first coal-fired power plant in Puerto Rico. The facility operates two circulating fluidized bed boilers with a combined maximum heat input rate of 4,922 million British thermal units per hour (MMBtu/hour).

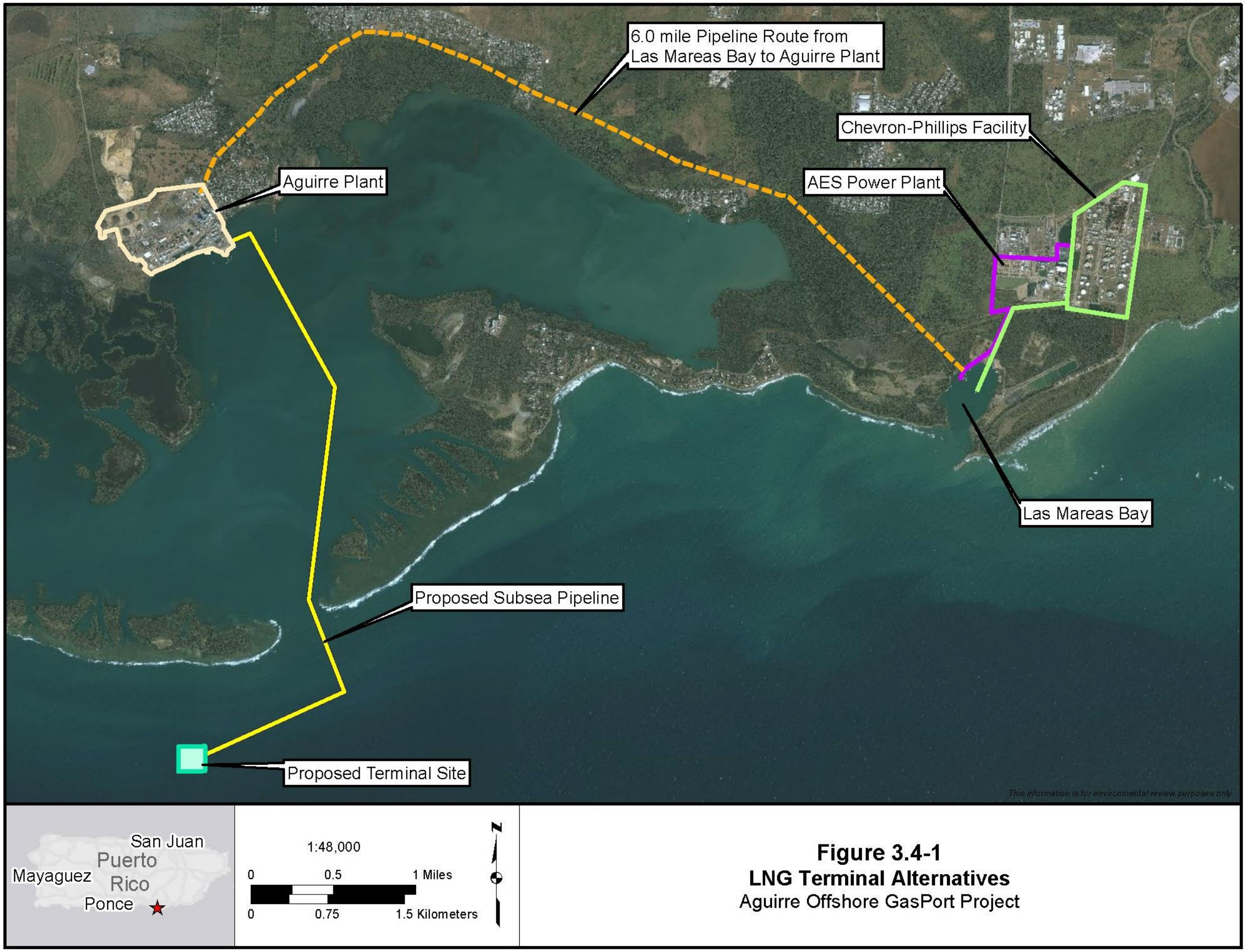

Figure 3.4-1
LNG Terminal Alternatives
Aguirre Offshore GasPort Project

TABLE 3.4-1

Comparison of Onshore and Dockside LNG Terminal Locations for the Aguirre Offshore Gas Port Project

Location	Distance to Aguirre Plant	Advantages	Disadvantages
Onshore			
Las Mareas Bay	6.0 miles (9.7 km)	• Industrial area with existing infrastructure, including a pier into Las Mareas Bay. However the pier would require reinforcement and enlargement to accommodate LNG carriers.	• Portions of facility may require construction in wetlands. • Dredging of an access channel would be required. • Requires construction of 6.0 miles (9.7 km) onshore pipeline.
Aguirre Plant	Adjacent	• Requires minimal pipeline to reach the plant.	• Dredging of existing barge channel would be required. • Potential sedimentation impacts on surrounding mangrove. • Requires acquisition or condemning of lands to construct facility. • Close proximity to the Aguirre community.
Dockside			
Las Mareas Bay	6.0 miles (9.7 km)	• Industrial area with existing infrastructure, including a pier into Las Mareas Bay. However, the pier would require reinforcement and enlargement to accommodate LNG carriers.	• Dredging of an access channel would be required. • Requires construction of 6.0 miles (9.7 km) onshore pipeline.
Aguirre Plant	Adjacent	• Requires minimal pipeline to reach the plant.	• Dredging within Jobos Bay for turning basin would be required. • A dockside facility located directly at the Aguirre Plant site would also have similar public safety concerns as a land-based terminal at the site.

This industrial area has sufficient land to allow for the development of an onshore LNG facility. Based on a review of aerial photography, we determined that additional development at the existing Chevron-Philips facility would be required to construct an onshore or dockside terminal. The area near the AES facility has sufficient land to allow development. Either site would create disturbance in areas that mainly consist of previously developed upland and palustrine emergent wetlands located along the coastal area.

To complete the onshore or dockside facility, the Las Mareas Bay entrance would need to be expanded to allow for tug-assisted mooring as required for LNG at the existing pier. The existing 700-foot-long (213 m) pier was designed for receipt of coal ships. The pier would need to be reinforced and enlarged to allow for the docking of an LNG carrier, which would be approximately 500 or 720 feet (152 or 220 m) in length. The modifications to the pier would likely require significant work within Las Mareas Bay. In addition to the in-water work of enlarging the pier, dredging would be required in the existing barge channel for additional depth to accommodate an LNG carrier delivering at the pier. A typical LNG carrier transporting approximately 170,000 m^3 requires a minimum water depth of 45 feet (14 m) when fully loaded. Finally, an alternative site located near Las Mareas Bay would require 6.0 miles (9.7 km) of an onshore pipeline to reach the Aguirre Plant. We conclude that the associated environmental impacts with this alternative from construction of the onshore pipeline and new facility and dredging offshore would be greater than the proposed Project. For these reasons, we conclude that a new land-based or dockside LNG facility within Las Mareas Bay would not present any significant environmental advantage compared to the proposed Project.

3.4.2 Aguirre Plant

We reviewed the Aguirre Plant as an alternative location for both a land-based terminal facility and a dockside terminal facility. Similar to the Las Mareas Bay on shore site, the land based terminal would require the construction of storage tanks, regasification equipment, and other infrastructure to support the facility. Based purely on land requirements, an efficiently designed LNG regasification plant with two tanks and a throughput capacity of 500 MMscf/d can be sited on as little as 30 acres (31 cuerdas) of land. For example, the EcoEléctrica facility with a similar throughput and storage capacity plus a separate power plant and desalination plant is sited on about 36 acres (37 cuerdas). In reviewing the area around the Aguirre Plant, 30 contiguous acres (31 cuerdas) are not available that would avoid population centers. In addition, the land-based terminal would require deepwater access and a turning basin. The lack of available land, the need to create deepwater access with turning basin, and the proximity to a population center makes a land-based terminal less environmentally preferable than the Proposed Action. Therefore, we do not recommend it.

We also reviewed the dockside terminal alternative for the Aguirre Plant. A dockside terminal facility would require deepwater access and a turning basin large enough for both the FSRU and the LNG carrier as well as modification at the plant to build a pier for the FSRU. The existing pier at the facility can not accommodate an FSRU as well as the LNG carrier. The land disturbance for a dockside facility is less than a land-based alternative as the regasification facilities, and the LNG storage tanks are onboard the FSRU. However, a dockside LNG facility has similar safety concerns for the Aguirre community as a land-based terminal alternative. A dockside facility would create short-term impacts on water quality, vegetation (seagrasses), and threatened and endangered species when in-water construction activites would occur.

The dockside LNG terminal would be preferable to a land-based terminal due to limited onshore construction requirements; however, due to its proximity to the Aguirre community, and the extensive amount of in-water work (dredging and pier construction) that would be required, we consider the environmental impacts would be equal or greater than the proposed Project. Therefore, we conclude that a land based or dockside facility at the Aguirre Plant offers no significant environmental advantage over the Proposed Action. As such, we are not recommending this alternative.

3.5 OFFSHORE TERMINAL SITE ALTERNATIVES

To serve as a viable site alternative to the proposed site, offshore terminal sites were further evaluated based on the following criteria:

- reasonably close to the Aguirre Plant (to minimize the required pipeline length);
- located in sufficient water depths (greater than 45 feet (14 m) depth) to accommodate the terminal design;
- avoids sensitive marine resources;
- avoids population centers that could potentially create increased impacts on recreational users, safety concerns, and visual impacts; and
- has a stable seafloor with favorable wind and wave data.

In considering the impact of each terminal from a safety concern, we reviewed the LOR Analysis of the proposed site (appendix A, section 1) conducted by the USCG. This May 2014 document recommends that the proposed terminal site implement a 500-yard (457 m) safety zone. The safety zone would prohibit any vessel traffic from entering or transiting this area without permission from the COTP. The safety zone was determined by considering a worst-case impact from an LNG spill and considered factors including maritime commerce, regional impact, and cultural and economic impact. It determined that the recommended safety zone at the proposed terminal site would minimally affect local recreational and fishing vessels that may have traditionally transited this area. The USCG noted in its LOR Analysis that the siting of the terminal site near the cays could be a critical issue for the fishing community if the safety zone extended beyond the 500 yards (457 m). Additionally, it noted that the Project in the "midst of the Cays threatens to severely hamper the ecotourism and recreational activities" (page 18, LOR Analysis).

For purposes of this analysis, we used the same safety zone recommendation to compare the alternative terminal sites as well as considered the impact on fishing, recreational activities, and ecotourism. If another site is determined to be preferred and is recommended by the FERC staff, the USCG would need to conduct a review of the site and make its determination on suitability and safety considerations.

During the draft EIS comment period, FERC received comments from the EPA, COE, NMFS, DNER, and several private commentors regarding the location of the offshore terminal site. Due to the 500 yard (457 m) safety perimeter around the proposed offshore terminal site, the commentors expressed concern about impacts on recreation and artisanal fishing in the area. Commentors requested that alternative sites located further south of the cays and known reef areas be identified to avoid impacts on recreational users and sensitive resources.

There are a number of site locations for the offshore terminal site along the southern coast of Puerto Rico. A reasonable alternative site would be required to be close to the Aguirre Plant, have sufficient depth to accommodate the offshore terminal site, avoid sensitive resources as well as population centers, and have a stable seafloor with favorable wind and wave data. We evaluated four alternative offshore terminal sites with pipelines to the terminal based on Aguirre LLC's field review of each site and corresponding pipeline. The sites identified as possible alternative site locations are located offshore of Cayos Caribes (Sites 1 and 2), Cayos de Barca (Site 3), and Cayos de Pájaros (Site 4). Table 3.5-1 provides information about the proposed Offshore GasPort site as well as each alternative site by criteria. The proposed Offshore GasPort site and the alternative sites are shown in figure 3.5-1.

In accordance with CEQ regulations, we determined that the proposed site was feasible and would not result in a significant environmental impact. To make this determination, we considered Aguirre LLC's mitigation plans, agency comments received, and our recommendations within this EIS. Based on our analysis of the proposed site and the alternative sites, we found no compelling reason to review additional alternative sites.

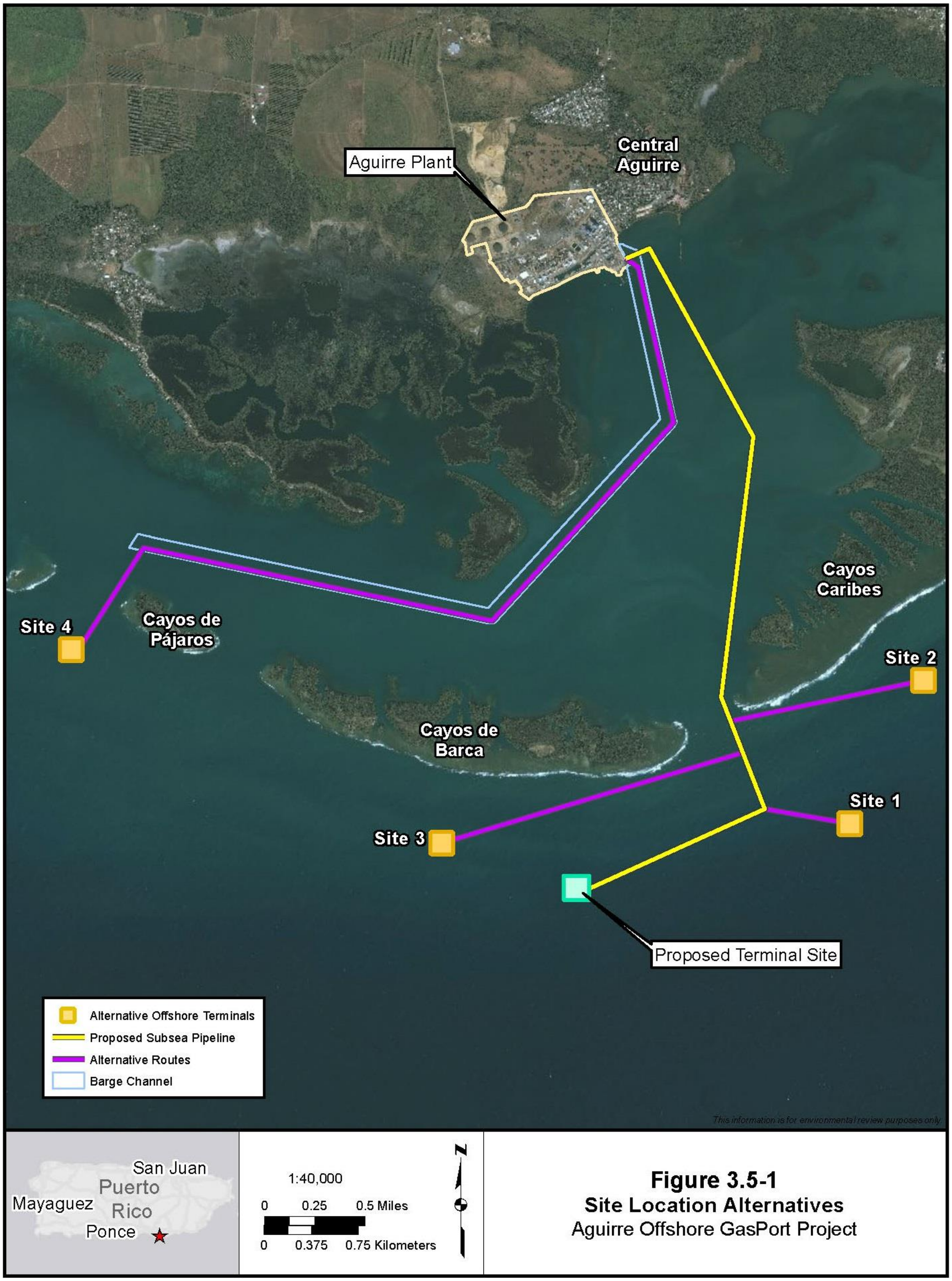

Figure 3.5-1
Site Location Alternatives
Aguirre Offshore GasPort Project

TABLE 3.5-1

Comparison of Proposed Offshore GasPort Site Alternatives for the Aguirre Offshore Gas Port Project

Offshore	Length of Pipeline to Aguirre Plant (miles [km])	Water Depth at Terminal Site (feet [m])	Marine Resources Present	Distance to Closest Population Centers	Seafloor Condition
Proposed Site	4.0 (6.4)	60 (18)	Designated as critical habitat for Elkhorn and Staghorn coral; patch reef, macroalgae and seagrass present	3.0 miles (4.8 km) southwest of Punta Pozuelo; 3.3 miles (5.3 km) south of Aguirre community.	Favorable
Site 1	3.6 (5.8)	60 (18)	Designated as critical habitat for Elkhorn and Staghorn coral; unknown benthic cover	2 miles (3.2 km) southwest of Punta Pozuelo; 3.2 miles (5.2 km) southeast from Aguirre community	Unfavorable
Site 2	4.0 (6.4)	55 (17)	Designated as critical habitat for Elkhorn and Staghorn coral; unknown benthic cover	1.1 miles (1.8 km) southwest of Punta Pozuelo; 2.7 miles (4.4 km) southeast from Aguirre community	Favorable
Site 3	4.7 (7.6)	60 (18)	Designated as critical habitat for Elkhorn and Staghorn coral; softbottom and macroalgae present	3.5 miles (5.6 km) southwest of Punta Pozuelo; 3.2 miles (5.2 km) south from Aguirre community	Not determined
Site 4	4.6 (7.4)	55 (17)	Designated as critical habitat for Elkhorn and Staghorn coral; softbottom and macroalgae present	1.7 miles (2.7 km) south of Las Mareas, Salinas; 3.1 miles (5 km) southeast of Salinas	Favorable

Source: NMFS, 2008; Tetra Tech, 2012; Tetra Tech, 2014a, 2014d

Proposed Terminal Site (Offshore GasPort)

The proposed site is located about 3,900 feet (1.2 km) southwest and directly offshore of the eastern tip of Cayos de Barca. From the proposed site, the pipeline would proceed northeast for about 0.9 mile (1.5 km), then turn northward through the Boca del Infierno pass for about 0.6 mile (1.0 km). Once through the Boca del Infierno pass, the pipeline would head northward through Jobos Bay for about 1.3 miles (2.1 km), then turn northwesterly for 1.0 mile (1.6 km), then turn west for 0.1 mile (0.2 km) where it would enter the Aguirre Plant from the east.

As presented and discussed in further detail in section 4.0 of this draft EIS, the proposed terminal site would encompass about 75.5 acres (77.7 cuerdas), of which 22.3 acres (22.9 cuerdas) would be permanently impacted. Construction activities would temporarily disturb 71.4 acres (73.5 cuerdas) of submerged aquatic vegetation (SAV) (e.g., seagrasses, macroalgae) and 4.1 acres (4.2 cuerdas) of coral reef habitat. Of these SAV and coral reef impacts, permanent habitat losses impact 22.1 and 0.2 acres (22.7 and 0.2 cuerdas), respectively. Coral reef habitat surveys for the alternative terminal sites were not conducted.

This site meets the criteria established for site selection. It is reasonably close to the Aguirre Plant, located in sufficient water depth to accommodate receipt of LNG carriers, avoids population centers, and has a stable seafloor. This site is advantageous because it is located the greatest distance from population's centers as well as from the cays. This site would have fewer permanent impacts on recreational users of the area compared to the alternative sites. In addition, it is the site located the furthest from population centers thus mitigating concerns over the safety zone imposed on the facility.

Site 1

Site 1 is located about 4,600 feet (1.4 km) southeast of the western tip of Cayos Caribes, offshore from the Boca del Infierno pass. From Site 1, the pipeline would proceed northwest for about 0.5 mile (0.8 km), then turn northward through the Boca del Infierno pass for about 0.6 mile (1.0 km). Once through the Boca del Infierno pass, the pipeline would follow the proposed route for the remaining 2.5 miles (4.0 km). The pipeline required for this site would be shorter than the proposed route but would cross the same coral reef habitat and other sensitive resources.

Site 1 is reasonably close to the Aguirre Plant and it is located in water depths that would accommodate the terminal operations. It is closer to a population center (Punta Pozuelo) than the proposed site and could create a visual impact on the community. In addition, this site is in an area that was noted to have a geologic anomaly during the geotechnical work completed by Aguirre LLC. For these reasons, we conclude that Site 1 is not be a reasonable alternative and does not provide a significant environmental advantage compared to the proposed site. Therefore, Site 1 was not evaluated further.

Site 2

Site 2 is located about 3,300 feet (1.0 km) southeast of the western tip of Cayos Caribes, offshore from the Boca del Infierno pass. From Site 2, the pipeline would proceed west for about 0.9 mile (1.4 km), then turn northward through the Boca del Infierno pass for about 0.6 mile (1.0 km). Once through the Boca del Infierno pass the pipeline would follow the proposed route for the remaining 2.5 miles (4.0 km). The pipeline length would be about the same length as the proposed route and it would cross the same coral reef habitat and other sensitive resources as the proposed pipeline.

This site is reasonably close to the Aguirre Plant and is in shallower water than the proposed site but still within the acceptable range for a LNG offshore terminal. Site 2 is closer to Punta Pozuelo than the proposed site and could create a visual impact on the community. There is less potential for a visual impact on the Central Aguirre community as Cayos Caribes lies between Site 2 and the community and the cays would act as a visual barrier. The USCG has recommended a 500-yard (457 m) safety zone for Site 2 (see figure 3.5-2), there is greater potential for impact on recreational users as it is nearer to the shoreline of the cays, where more recreational users are present. These recreational users would be restricted from entering the safety zone without prior authorization from the COTP.

Site 2 would have greater permanent environmental impacts than the proposed site due to its proximity to population centers, visual impact, and recreational impacts. For these reasons, we conclude that Site 2 is not a reasonable alternative and does not provide a significant environmental advantage compared to the proposed site. Therefore, Site 2 was not evaluated further.

Site 3

Site 3 is located about 5,700 feet (1.7 km) southwest and directly offshore of the eastern area of Cayos de Barca. From Site 3, the pipeline would proceed east for about 1.6 miles (2.6 km) then turn north through the Boca del Infierno pass for about 0.6 mile (1.0 km). Once through the Boca del Infierno pass, the pipeline would follow the proposed route for the remaining 2.5 miles (4.0 km). This site, similar to the proposed site, is reasonably close to the Aguirre Plant and is located in a water depth that would accommodate the Offshore GasPort. The terminal site would be approximately 0.1 mile (0.2 km) closer to Central Aguirre and approximately 0.5 mile (0.8 km) further from Punta Pozuelo. The visual impact of this site would be similar to the proposed site as both sites are south of Cayos de Barca.

Figure 3.5-2
U.S. Coast Guard Recommended Safety Zone
Aguirre Offshore GasPort Project

The USCG's recommended 500-yard (457-m) safety zone would apply to Alternative Site 3 (see figure 3.5-2), resulting in a greater permanent impact on recreational boating and fishing resources because it is about 675 yards (617 m) south of the Cayos de Barca and about 300 yards (274 m) closer to the mainland than the proposed site. This nearshore location is less favorable as a higher volume of recreational boating and fishing activity occurs here, and the site creates potential safety concerns due to its proximity to these popular activities.

The environmental impacts associated with Site 3 would be comparable to the proposed site; however, due to the proximity of Site 3 to Cayos de Barca and the mainland, there would be greater permanent recreational impacts and safety concerns to individuals or groups utilizing the resources of Cayos de Barca. While Site 3 does not present any significant environmental advantages as compared to the proposed site, it is further evaluated in section 3.6 because the site presents additional pipeline routing alternatives.

Site 4

Site 4 is located about 2,000 feet (0.6 km) southwest of Cayos de Pájaros. From Site 4, the pipeline would proceed northeast for about 0.6 mile (1.0 km) to the existing barge channel where it would proceed about 1.8 miles (2.9 km) east within the basin of Jobos Bay. The pipeline would then proceed northeast for about 1.3 miles (2.1 km) within the basin of Jobos Bay and turn north at about MP 3.7 northwest for 0.9 mile (1.4 km) to the Aguirre Plant property where it would interconnect with existing Aguirre Plant piping.

This site, similar to the proposed site, is reasonably close to the Aguire Plant and is in a water depth that would accommodate the Offshore GasPort. Due to its closer proximity to the communities and the mainland shoreline, the offshore area of Site 4 experiences greater use by recreational boating and fishing users than the other terminal sites considered. DNER staff monitoring land use in the area noted that Cayo Matias, to the west of Cayos de Pájaros, is intensively used by recreational boaters year round (Lilyestrom, 2014). Cayos de Pájaros is used for "spill-over" boats when Cayo Matias is overcrowded. As shown on figure 4.7.4-1, Cayos de Pájaros includes recreational areas for swimming, hiking, diving, and contains a public boat ramp. The DNER reports that the area is used by divers collecting the West Indian topshell for recreational and commercial use (Lilyestrom, 2014). The West Indian topshell is collected as a food source, fishing bait, and a unique black and white striped shell. Assuming that the USCG would recommend a 500-yard (457 m) safety zone for Site 4 (see figure 3.5-2), there would be greater permanent impacts on recreational boating and fishing activities as the area near the two islands (Cayo Matias and Cayos de Pájaros) would not allow recreational and fishing boat to traverse the area. The marine traffic would be required to traverse to the north of Cayo Morrillo and Cayos de Pájaros remaining within the Jobos Bay area or traverse further to the south to reach the southeastern end of Cayos de Pajoros and thus avoid the safety zone. Finally, Site 4 would present a greater visual impact on the community of Las Mareas and shoreline residents due north of the facility. The Offshore GasPort including the FSRU would be visible to residents and tourists who may frequent the area.

Site 4 would result in greater permanent impacts on the recreational boating and fishing activities in the area, as well as create a greater permanent visual impact than the proposed site. However, due to concerns about pipeline construction through the Boca del Infierno pass (which this alternative would avoid), Site 4, similar to Site 3, is further evaluated in section 3.6.

3.6 MAJOR PIPELINE ROUTE ALTERNATIVES

We received comments during scoping as well as during the public comment period for the draft EIS from community members, organizations, and agencies (COE, NMFS, EPA, FWS, and DNER) concerning impacts from the proposed pipeline route on federally threatened and endangered coral species, coral reef habitat, seagrass within Jobos Bay, Antillean manatee, and recreational and commercial users. During preliminary project planning, Aguirre LLC investigated several construction methods for the pipeline in Jobos Bay including trenching, HDD, and direct lay on the seafloor. Early in the pre-filing process, Aguirre LLC established its proposed construction method to be direct lay in an attempt to minimize impacts on sensitive resources in Jobos Bay. Several agencies recommended that the barge channel, currently used for oil barges to the Aguirre Plant[1], should be evaluated as an alternative location for the pipeline on the assumption that construction and operation impacts would be fewer because the barge channel seafloor area is previously disturbed. Following these recommendations, Aguirre LLC completed review of several alternative pipeline routes. Aguirre LLC provided information on alternatives in its original application (April 2013), in a subsequent data response (June 2013), and in supplemental information filings provided in January 2014 through January 2015. These additional filings provided specific information on potential construction methods as well as environmental impacts from the construction of the proposed and alternative pipeline routes.

As discussed in section 2.3.4 of this final EIS, in order to meet DOT requirements in 49 CFR 192, Aguirre LLC has modified its construction method to bury the pipe in all areas except for the 1,700 feet (518 m) located within the Boca del Infierno pass. Aguirre LLC proposes to direct lay the pipe over the top of the coral reef in this area and protect the pipeline with concrete mats. In addition, at each bend in the pipeline, additional mats would be laid to protect the pipeline.

Due to the complexity of the Project that includes selection of a LNG terminal site and a connecting pipeline route, we chose to review a combination of alternative terminal sites (previously discussed in section 3.5) and pipeline routes. We used the alternative criteria (technically and economically feasible and practical; offer significant environmental advantage over the proposed Project; and meet the proposed Project objectives) as well as proximity to the Aguirre Plant (to minimize the required pipeline length) to evaluate each site/pipeline alternative. Other objectives we used in analyzing each alternative was avoiding sensitive marine resources as well as areas of commercial and recreational value; avoiding population centers; and avoiding significant visual impacts on the existing viewscape.

The Project's objectives are to diversify the fuel supply to the Aguirre Plant while meeting the EPA MATS rule. Each of the terminal and pipeline route alternatives considered in this section would meet the Project's objectives. Terminal Sites 3, 4, and the Proposed Site along with five variations of a subsea pipeline route were developed for further review as shown on figure 3.6-1.

[1] There are no federally regulated shipping lanes in the vicinity of terminal site; traffic along the coast is mainly recreational and smaller sized fishing boats. There is a privately maintained navigational channel used by PREPA to deliver fuel oil to the Aguirre Plant.

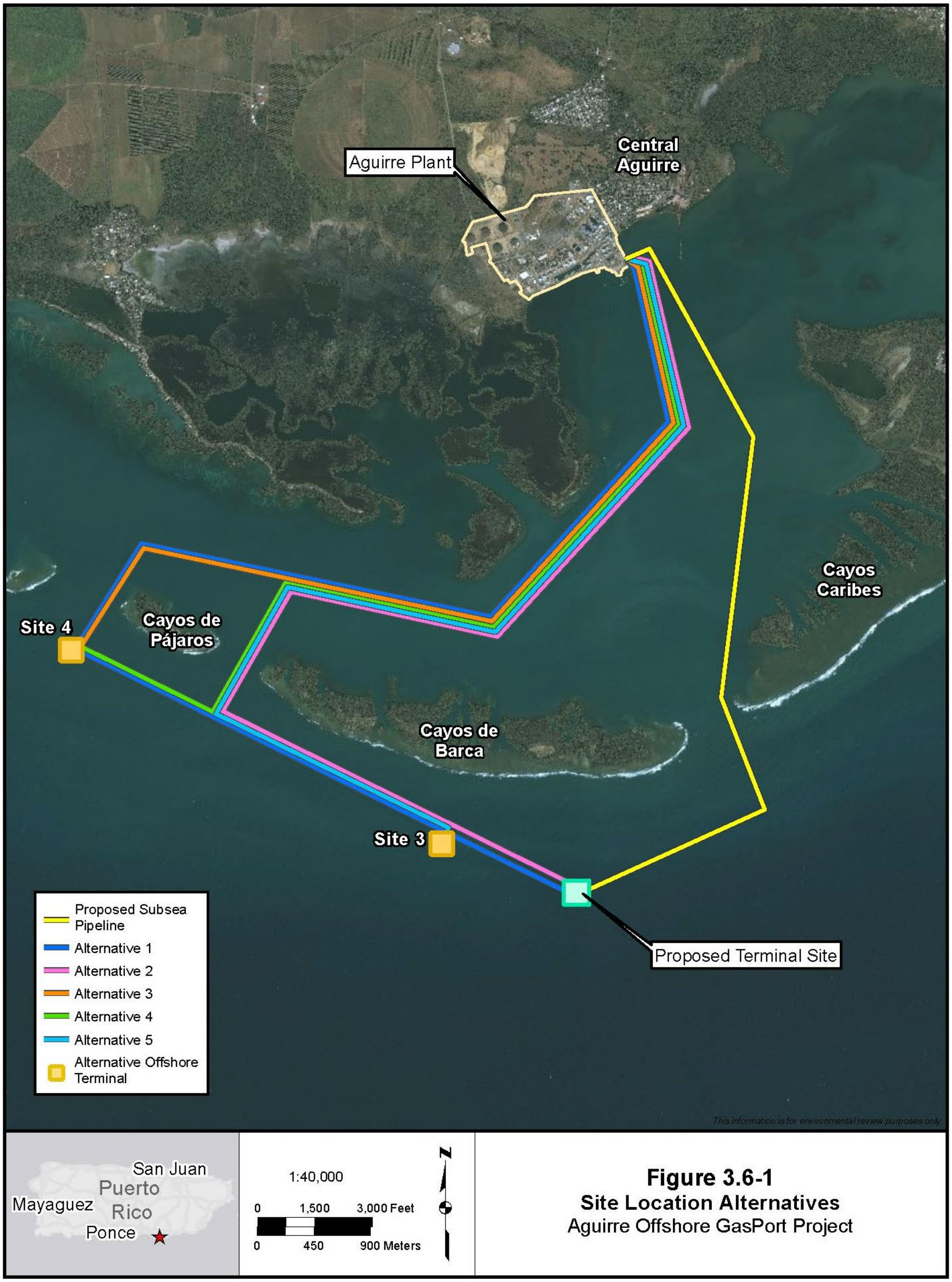

Figure 3.6-1
Site Location Alternatives
Aguirre Offshore GasPort Project

Pipeline Installation Methods

An important factor in reviewing the pipeline route alternatives is the construction method to be used to install the pipeline. Traditionally, a subsea pipeline can be installed using the HDD construction method (water-to-water drill or water-to-land drill), trenching and backfill, or direct lay. The HDD construction method is commonly used to avoid sensitive resources, contaminated sediments, or areas where construction vessels may be hazardous. Directional drilling minimizes impacts on resources, but the process is not suitable to all areas.

The HDD construction method has been in use since the 1970s as a means to install pipelines across rivers and at shore approaches to eliminate pipeline exposure from erosion and scour and to eliminate impacts on water quality from construction activities within the waterbody. This method allows for trenchless construction across an area by pre-drilling a hole well below the depth of a conventional pipeline lay and then pulling the pipeline through the pre-drilled borehole. Pipelines up to 60 inches (1.5 m) in diameter have been successfully installed using this method. The length of pipeline that can be installed by the HDD construction method depends upon soil conditions and pipe diameters and is limited by available technology and equipment sizes. A directional drilling rig would be set up and a small-diameter pilot hole would be drilled along a prescribed profile. Once the pilot hole is completed, it would be enlarged using reaming tools to provide access for the pipe. The reaming tools would be attached to the drill string at the exit point of the pilot hole and then rotated and drawn back to the drilling rig, thus progressively enlarging the pilot hole with each pass. During this process, drilling fluid consisting primarily of bentonite clay and water would be continuously pumped into the hole to remove cuttings and maintain the integrity of the hole. Once the hole has been sufficiently enlarged, the prefabricated segment of pipe would be attached behind the reaming tool on the exit side of the crossing and pulled back through the drill hole to the drill rig, completing the crossing.

As requested in the draft EIS, Aguirre LLC conducted additional work to determine the feasibility and risk of installing the pipeline through the Boca del Infierno pass using the HDD construction method. Aguirre LLC reviewed the geotechnical subsurface data and the preliminary nearshore geotechnical investigation conducted for the Project and determined that a successful HDD of this area would be infeasible based on the subsurface geotechnical data currently available. The report concluded that a detailed subsurface exploration program would be required to determine the feasibility and detailed design of an HDD to cross the Boca del Infierno pass. We are recommending that Aguirre LLC continue to conduct the necessary subsurface investigations to determine the likelihood of a successful HDD. As the success of the HDD is unknown for the Boca del Infierno pass, our analysis assumes a direct lay through coral areas of the proposed route and each of the alternative routes including the use of concrete mats at required locations.

Offshore pipeline trenching (to lower the pipeline) and backfill (to cover the pipeline) can be accomplished using plowing, jetting, or conventional bucket dredge construction methods. Plowing involves laying the pipeline on the bottom and then dragging a plow along the seafloor using the pipeline to guide the plow. The plow simultaneously casts the bottom sediment to the sides of the trench and lowers the pipeline into the trench. After the pipeline is placed in the trench, the plow is reversed and dragged along the trench, refilling the trench with the material cast out of the trench during plowing. In general, the advantage of plowing is that it creates less sediment resuspension (plume) than jetting or dredging. The disadvantage includes the large size of the plow and plow vessel, which creates a sizable area of disturbance from the anchorage requirements and water depth needed to successfully pull a plow. In addition, plowing requires a minimum water depth of 23 feet (7 m). In water depths of less than 23 feet (7 m), the plow would only be partially submerged and the increased weight creates a large increase in the pull force required. Most large barges with suitable equipment to pull a plow are unable to operate in waters less than 23 feet (7 m) deep.

Jetting involves using a hydraulic jet of ocean water to liquidize the sediments out of the trench, and then lowering the pipeline into the trench. Jetting methods include use of a jet sled or use of hand tools by divers. The advantage of jetting is the ability to operate in shallower water depths than a plow. Jetting can also create a deeper trench by using multiple passes provided bottom sediments are suitable. Disadvantages of jetting include increased sediment plumes and potential trench slumping. Trench slumping would require additional jetting activities, resulting in further sedimentation and increasing risk of secondary impacts on SAV, corals, and marine wildlife. A plume from jetting can be suspended for a long period and can be transported over longer distances than the sediment plume from a plow or dredge operation. Small jet sleds can operate in shallow water depths; however, it requires a greater in-water construction duration as the jet sled speed is reduced (Bai and Bai, 2005; Ocean Engineering Systems, Undated). Hand jetting as proposed by Aguirre LLC for the Project is further explained in section 2.3.4.2. Aguirre LLC filed its Pipeline Installation Procedures on December 16, 2014. In these procedures, Aguirre LLC proposes to use hand jetting with a jet section head and diffuser with turbidity frame and curtain to minimize impacts.

Dredging involves removing material from the bottom to construct a trench for the pipeline, laying the pipeline in the trench, and then returning the dredged material to cover the pipeline or allowing natural currents to refill the trench. The advantage of dredging is its ability to remove a large volume of material, and ability to work in shallow water. The disadvantages include sedimentation and water quality impacts, and a longer in-water construction period.

The direct lay construction method fabricates the pipeline segments on pipe lay barges and lowers the pipeline to the seafloor using floats or other equipment to lay the pipeline. The direct lay method does not bury the pipeline. The advantage of direct lay is that the area of disturbance for construction of the pipeline is minimal when compared to other construction methods. The disadvantage of direct lay is the pipeline has a greater risk of being damaged from human or natural incidents that occur.

To review the construction alternatives, we considered plowing, jet sled and hand jetting, dredging, and direct lay as potential construction methods for pipeline installation. Due to the size of operational vessels, plowing to bury the proposed pipeline route or any alternative routes would affect a large area of seafloor. In addition, there are areas along the route where the route depth is less than 23 feet (7 m) deep, which could require dredging to attain the necessary depth to move the plow equipment through the area. Therefore, due to increased area of seafloor that would be disturbed to bury the pipeline, it was determined that plowing would not be a reasonable alternative.

Use of a jet sled to bury the pipe would require a marine vessel to pull the jet sled and it would impact a large area of the seafloor; more critically, the jet sled would create sediment plumes with each successive pass, dispersing benthic materials over the seafloor. If the pipe were buried using a jet sled, no environmental advantage would occur. Therefore, we reviewed the proposed route and alternative routes assuming the pipeline would be installed using a hand jet to bury the pipeline in all areas required and direct lay in areas where pipe burial would not be required.

Potential Impacts Associated with Terminal Sites and Pipeline Routes

We developed our alternative terminal locations and pipeline routes based on the information provided by Aguirre LLC and recommendations from the COE, EPA, FWS, and DNER. We considered the following alternative terminal and subsea pipeline routes:

1. proposed site and proposed subsea pipeline route;
2. proposed site and subsea pipeline route alternative 1 that runs to the northwest past Cayos de Pájaros, turning north between Cayos de Pájaros and Cayo Morrillo, and then turning northeast using the existing disturbed barge channel route to access the Aguirre Plant;
3. proposed site and pipeline route alternative 2 that runs to the northwest past Cayos de Barca, turning north between the two cays (Cayos de Pájaros and Cayos de Barca), and then turning northeast using the existing disturbed barge channel route to access the Aguirre Plant;
4. Terminal Site 4 and pipeline route alternative 3 that runs to the northeast turning to enter the existing disturbed barge channel route to access the Aguirre Plant;
5. Terminal Site 4 and pipeline route alternative 4 that runs to the southeast past Cayos de Pájaros, turning north between the two cays (Cayos de Pájaros and Cayos de Barca), and then turning northeast using the existing disturbed barge channel route to access the Aguirre Plant;
6. Terminal Site 3 and pipeline route alternative 5 that runs northwest past Cayos de Barca, turning north between the two cays (Cayos de Pájaros and Cayos de Barca), and then turning northeast using the existing disturbed barge channel route to access the Aguirre Plant; and
7. proposed site and pipeline route alterative 6 that runs to the northwest past Cayos de Pájaros, turning north between Cayos de Pájaros and Cayo Morrillo, and then turning northeast using the existing disturbed barge channel route to access the Aguirre Plant.

Typically, the depth of burial of a pipeline is set by COE or DOT regulations and is dependent upon usage (e.g., fairway, federal channel) and water depth. In research on the barge channel, we (along with the COE and EPA) have determined that it is not a federally regulated barge channel. It is maintained by PREPA to allow for barge traffic to reach its facility. In follow-up comments received from PHMSA, PHMSA communicated that 49 CFR 192.307 requires 4 feet of bury for pipe installed in a navigable river, stream, or harbor; that pipe installed offshore in water depths less than 12 feet deep must be installed with a minimum cover of 3 feet between the top of the pipe and the natural bottom; and pipe under water of 12 feet or greater must be installed so that the top of the pipe is below natural bottom, unless the pipe is supported by stanchions, held in place by anchors or heavy concrete coating, or protected by equivalent means. PHMSA also notes that, if the pipeline were placed in the barge channel, its required depth would be 4feet (1.2 m) below the dredge depth (current or future) of the channel. Therefore, for purposes of this alternatives review, we assumed the pipeline would be buried with 4 feet (1.2 m) of cover throughout the entire barge channel.

As discussed in section 2.3, the pipeline would be installed using hand jetting to bury the pipe to below grade of the natural sea bottom or bury the pipe to below 3 feet (1 m) of cover depending upon the water depth, except in areas of coral reef where the pipeline would be not be buried but would be covered with concrete mats. The proposed pipe laying and burial activities would require a 20-foot (6 m) wide workspace on the seafloor in coral reef areas, 40-foot (12 m) wide workspace along the remainder of the pipeline, and ATWS at each of the PIs. The permanent impacts on the seafloor would consist of the 8-foot-wide (2.4 m) concrete mats placed over the pipeline in coral reef areas (1,700 foot [518 m] crossing at the Boca del Infierno pass); at PIs 3, 4, and 5; and 1,300-foot (396 m) long section at the onshore approach. The temporary and permanent impacts along the alternative pipeline routes were calculated using the same footprints; installation of the pipeline within the barge channel was assumed to require a 40-foot (12 m) wide workspace to allow for hand jetting to establish 4 feet (1.2 m) of cover over the pipeline. Temporary and permanent impacts at the alternative terminal sites were assumed to be the same as the proposed site.

Table 3.6-1 summarizes the construction acreage impacts for the alternative terminal sites and associated pipeline routes. Each alternative's critical impact on environmental resources is summarized in table 3.6-2.

TABLE 3.6-1

Terminal and Pipeline Route Alternatives for the Aguirre Offshore GasPort Project

	Alternatives						
Selection Criteria	Proposed Terminal Site and Pipeline	Proposed Terminal Site and Pipeline Route 1	Proposed Terminal Site and Pipeline Route 2	Terminal Site 4 and Pipeline Route 3	Terminal Site 4 and Pipeline Route 4	Terminal Site 3 and Pipeline Route 5	Proposed Terminal Site and Pipeline Route 6
Pipeline Length (miles [km])	4.0 (6.2)	7.3 (11.7)	6.0 (9.7)	4.5 (7.2)	4.7 (7.6)	5.3 (8.5)	7.4 (11.9)
Pipeline Construction Method (miles [km])							
Pipe Lay Direct – Reef area [a]	0.4 (0.6)	0.7 (1.2)	0.5 (0.8)	0.3 (0.5)	0.3 (0.5)	0.5 (0.8)	0.4 (0.6)
Pipe Lay Direct – Hand jetting	3.6 (5.6)	6.6 (10.5)	5.5 (8.9)	4.2 (6.7)	4.4 (7.1)	4.8 (7.7)	7.0 (11.3)
Area of Disturbance (acres [cuerdas])							
Terminal	75.5 (77.7)	75.5 (77.7)	75.5 (77.7)	75.5 (77.7)	75.5 (77.7)	75.5 (77.7)	75.5 (77.7)
Pipe Lay Direct – Reef area [b]	0.9 (0.9)	1.8 (1.8)	1.1 (1.2)	0.8 (0.8)	0.8 (0.8)	1.1 (1.2)	0.9 (1.0)
Pipe Lay Direct – Hand jetting [c]	16.9 (17.4)	30.6 (31.5)	25.2 (25.9)	19.6 (20.2)	20.1 (20.7)	22.5 (23.2)	33.0 (34.0)
ATWS [d]	36.6 (37.7)	51.5 (53.0)	51.3 (52.8)	38.2 (39.3)	50.9 (52.4)	51.3 (52.8)	51.3 (52.8)
TOTAL	**129.9 (133.7)**	**159.4 (164.0)**	**153.1 (157.6)**	**134.1 (138.0)**	**147.3 (151.6)**	**150.4 (154.9)**	**160.7 (165.5)**

[a] Reef area includes consolidated and unconsolidated reef.
[b] Assumes a 20-foot-wide (6 m) area of disturbance.
[c] Assumes a 40-foot-wide (12 m) area of disturbance.
[d] ATWS refers to the temporary workspace around the PIs and near the onshore approach to the Aguirre Plant.

Proposed Terminal Site (Offshore GasPort) and Proposed Route (Proposed Action)

The proposed terminal site would be located in at least 60 feet (18 m) of water approximately 3 miles (4.8 km) directly south of the southern coast of Puerto Rico. To deliver natural gas to the Aguirre Plant, a 4.0-mile (6.4 km) pipeline would be laid from the offshore terminal to interconnect with the plant's piping. Construction details are provided in section 2.3 of this EIS.

The advantages of the proposed site and pipeline route are the shorter pipeline length required to connect to the Aguirre Plant, the reduced visual impact, and increased distance from major population centers.

TABLE 3.6-2

Acreage Impact From Proposed and Alternative Options for the Aguirre Offshore Gas Port Project

Selection Criteria	Alternatives: Proposed Terminal and Proposed Pipeline	Proposed Terminal and Pipeline Route 1	Proposed Terminal and Pipeline Route 2	Terminal Site 4 and Pipeline Route 3	Terminal Site 4 and Pipeline Route 4	Terminal Site 3 and Pipeline Route 5	Proposed Terminal and Pipeline Route 6 [a]
Temporary Coral Reef Impacts (acres [cuerdas])							
Terminal	4.1 (4.2)	4.1 (4.2)	4.1 (4.2)	0.0	0.0	0.0	4.1 (4.2)
Pipeline	0.9 (0.9)	1.8 (1.9)	1.1 (1.2)	0.8 (0.8)	0.8 (0.8)	1.1 (1.2)	0.9 (0.9)
ATWS	1.2 (1.2)	7.2 (7.4)	11.5 (11.8)	7.2 (7.4)	11.5 (11.8)	11.5 (11.8)	1.0 (1.1)
Total	6.2 (6.4)	13.1 (13.5)	16.7 (17.2)	8.0 (8.2)	12.3 (12.7)	12.6 (13.0)	6.0 (6.2)
Permanent Coral Reef Impacts (acres [cuerdas])							
Terminal	0.2 (0.2)	0.2 (0.2)	0.2 (0.2)	0.0	0.0	0.0	0.2 (0.2)
Pipeline	0.4 (0.4)	0.7 (0.7)	0.5 (0.5)	0.3 (0.3)	0.3 (0.3)	0.5 (0.5)	0.4 (0.4)
Total	0.6 (0.6)	0.9 (0.9)	0.7 (0.7)	0.3 (0.3)	0.3 (0.3)	0.5 (0.5)	0.6 (0.6)
Temporary SAV Impacts (acres [cuerdas])							
Terminal	71.4 (73.5)	71.4 (73.5)	71.4 (73.5)	3.3 (3.4)	3.3 (3.4)	10.6 (10.9)	71.4 (73.5)
Pipeline	10.2 (10.5)	3.2 (3.3)	2.5 (2.5)	1.3 (1.4)	0.6 (0.6)	0.6 (0.6)	3.9 (4.1)
ATWS	21.8 (22.4)	3.7 (3.8)	3.7 (3.8)	3.7 (3.8)	3.7 (3.8)	3.7 (3.8)	5.4 (5.6)
Total	103.4 (106.4)	78.3 (80.6)	77.6 (79.8)	8.3 (8.6)	7.6 (7.8)	14.9 (15.3)	80.7 (83.2)
Permanent SAV Impacts (acres [cuerdas])							
Terminal	22.1 (22.8)	22.1 (22.8)	22.1 (22.8)	0.0	0.0	2.6 (2.7)	22.1 (22.8)
Pipeline	<0.1 (<0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Total	22.1 (22.8)	22.1 (22.8)	22.1 (22.8)	0.0	0.0	2.6 (2.7)	22.1 (22.8)

[a] Route 6 is shown on figure 3.6-3 and discussed in further detail later in this section.

One resource impact that we note directly from table 3.6-2 is the impact on SAV for each of the alternative routes when compared to the proposed route. All of the alternative routes result in considerably less acreage of temporary impact on SAV than the proposed route. For example, Alternative Route 1 would impact about 6.9 acres (7.1 cuerdas) of SAV, whereas, 32.0 acres (32.9 cuerdas) of SAV would be temporarily impacted by the proposed route. Even considering the lesser impacts from the alternative routes, we believe that the proposed route's impacts on SAV would not be significant because these impacts represent only a fraction of the existing SAV present in Jobos Bay. In addition, natural regrowth would mitigate most of the construction-related impacts, and Aguirre LLC has submitted a draft Benthic Resource Mitigation Plan to address permanent impacts on seagrass (see section 4.4.3).

Proposed Terminal site and Alternative Pipeline Route 1

This alternative would use the proposed terminal site and would use a pipeline route that is 7.3 miles (11.7 km) in length, beginning at the proposed terminal (MP 0.0) and extending approximately 3.4 miles (5.5 km) offshore in a northwest direction before turning northeast between Cayo Morrillo and Cayos de Pájaros. The route then follows the existing barge channel across the basin of Jobos Bay to the Aguirre Plant property where the pipeline would interconnect with the power plant. Construction procedures for installation of the pipeline in open water outside Jobos Bay (between about MPs 0.0 and 3.4) would be the same as for the proposed route. The remaining 3.9 miles (6.3 km) would be within the barge channel, where hand jetting would occur to bury the pipe to obtain 4 feet (1.2 m) of cover over the pipeline.

The route alternative crosses areas of SAV, consolidated reef, and unconsolidated reef.[2] As shown in figure 3.6-2, the longest SAV area crossed is directly adjacent and a continuation of the resources located at the terminal site. The consolidated reefs are located northwest of the Cayos de Barca and represent formations that support a diverse assemblage of reef inhabitants. The unconsolidated reef habitat near the barge channel where the route alternative turns to the northeast would require disturbance. In addition, ATWS would be required to install the pipe bend to enter the barge channel.

Based on Project-specific surveys completed, construction of the pipeline along this alternative route would impact about 9.0 acres (9.3 cuerdas) of coral reef habitat, including 4.5 acres (4.6 cuerdas) of consolidated reef and 4.5 acres (4.6 cuerdas) of unconsolidated reef. This is about 6.9 acres (7.1 cuerdas) more than the coral reef habitat that would be impacted by the proposed route. Five federally threatened species of coral were documented in the reef habitat crossed by the alternative route, while seven species were observed along the proposed route.

Alternative Pipeline Route 1 would result in 83.9 acres (86.3 cuerdas) of disturbance, which is about 54 percent more than the proposed route (54.4 acres [56.0 cuerdas]). In addition, the route alternative is 3.3 miles (5.3 km) longer than the proposed route.

Impacts on visual resources for this alternative would be the same as the proposed terminal and pipeline route. This pipeline route alternative passes near and between Cayo Morrillo and Cayos de Pájaros, potentially impacting the recreational uses and commercial uses during the construction period.

Due to the coral reef habitat impacts, recreational and commercial impacts, and longer pipeline length, there are no environmental advantages to this alternative.

2 The consolidated reef habitat is characterized by well-developed low relief consolidated hardbottom formations supporting a rich and diverse assemblage of reef inhabitants. The unconsolidated reef is characterized by well integrated, low relief discontinuous hardbottom (rubble and rock out croppings), supporting a variety of sessile and motile organisms. Coverage and species richness observed during the benthic surveys were generally higher within the consolidated reef when compared to the unconsolidated reef. Stony coral cover was estimated to be 5 to 50 percent within the consolidated reef and less than 5 percent in the unconsolidated.

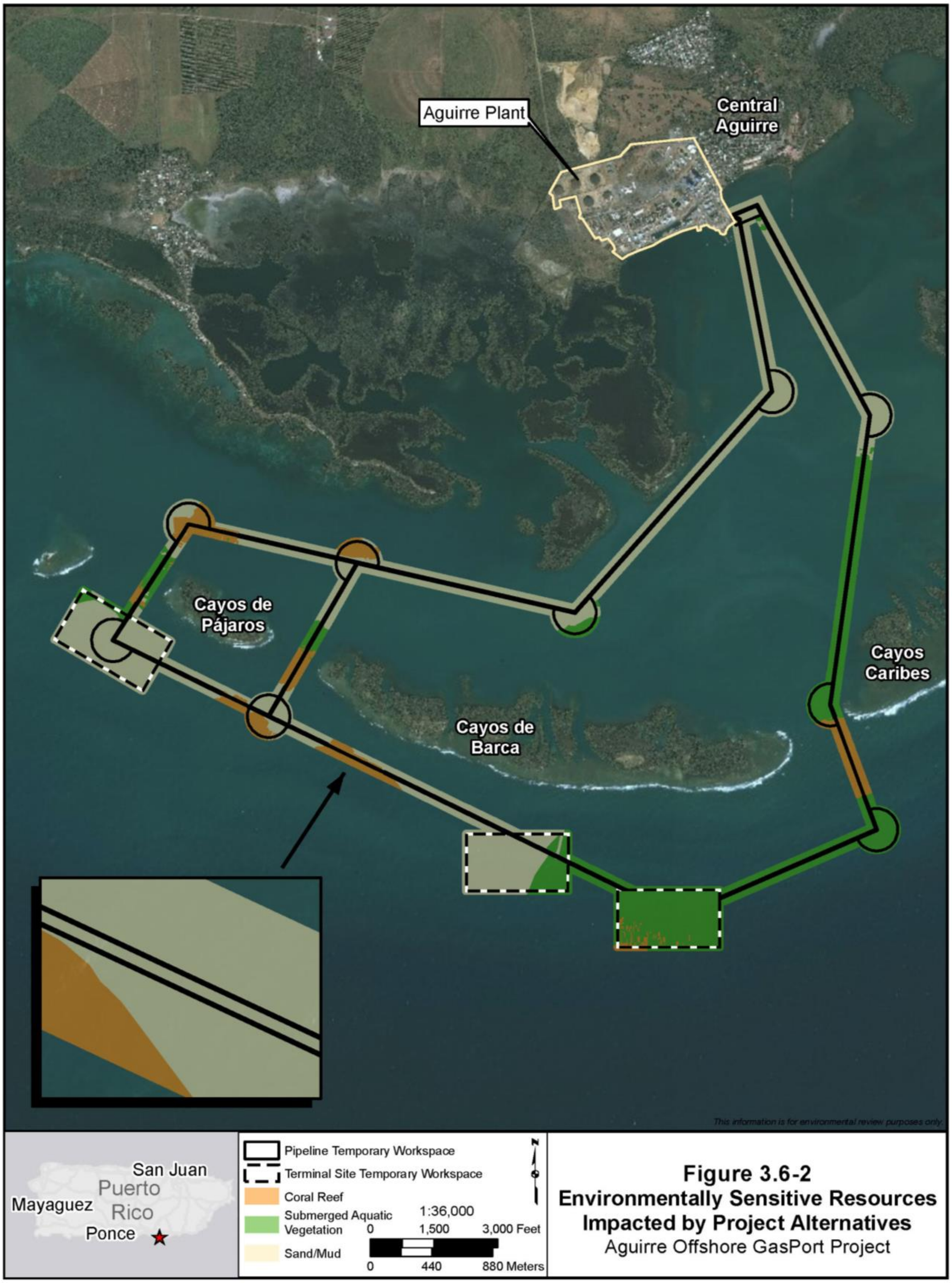

Figure 3.6-2
Environmentally Sensitive Resources Impacted by Project Alternatives
Aguirre Offshore GasPort Project

Proposed Terminal Site and Alternative Pipeline Route 2

This alternative would use the proposed terminal site and alternative pipeline route 2 that is about 6.0 miles (9.7 km) in length, beginning at the proposed terminal (MP 0) and extending approximately 2.8 miles (4.5 km) offshore in a northwest direction before turning northeast between Cayos de Barca and Cayos de Pájaros. The route then follows the existing barge channel across the basin of Jobos Bay to the Aguirre Plant property where the pipeline would interconnect with the power plant. Construction procedures for installation of the pipeline in open water outside Jobos Bay (between about MPs 0.0 and 2.8) would be the same as for the proposed route. The remaining 3.2 miles (5.1 km) would be within the barge channel, where hand jetting to achieve the 4 feet of cover would be required.

Similar to the previous route alternative, this route alternative crosses areas of SAV, consolidated reef, and unconsolidated reef. As shown in figure 3.6-2, the longest SAV area crossed is directly adjacent and a continuation of the resources found at the terminal site. This alternative route crosses coral reef habitat for both the pipeline and the ATWS areas required to install the pipeline. Construction of the pipeline would impact the water quality in the short term because sediment would be suspended during the construction period. Similar to the proposed pipeline route, Aguirre LLC would use a diffuser and silt curtain which should minimize the suspended sediment when burying the pipeline.

Based on Project-specific surveys completed, construction of the pipeline along this alternative route would impact approximately 12.6 acres (13.0 cuerdas) of coral reef habitat, including 6.5 acres (6.7 cuerdas) of consolidated reef and 6.1 acres (6.3 cuerdas) of unconsolidated reef. This is approximately 10.5 acres (10.8 cuerdas) more than the coral reef habitat that would be impacted by the proposed route. Five federally threatened species of coral were documented in the reef habitat crossed by this alternative route, while seven species were observed along the proposed route. In follow up conversations with NMFS and as indicated in NMFS' September 25, 2014 letter, it was noted that these coral reef areas near to shore were of lower quality than the coral reef areas located further from shore. However, NMFS' letter also specifically acknowledges that the benthic surveys indicate that the coral reef areas within the pass between Cayo Morrillo and Cayos de Pájaros contain less coral than this pass and in the Boca del Infierno pass, and there is a sand channel in the pass where the pipeline could be placed between reef areas.

Permanent visual impacts for this alternative (terminal and route 2) would be similar to the proposed Project. During construction, this pipeline route alternative passes near and between Cayos de Pájaros and Cayos de Barca. Commentors on the draft EIS noted that a high volume of recreational boating and fishing activity occurs near Cayos de Barca. Therefore, greater recreational impacts could occur during the construction of the alternative pipeline route in comparison to the proposed route. Following installation of the pipeline, there would be no permanent impacts along the pipeline route.

Alternative Pipeline Route 2 would result in 77.6 acres (79.9 cuerdas) of disturbance, which is about 43 percent more than the proposed route (54.4 acres [56.0 cuerdas]), with impacts on sensitive habitats, including federally protected coral species. In addition, this route alternative is 2 miles (3.5 km) longer than the proposed route. Therefore, for the reasons cited above, we conclude that this alternative, proposed Terminal Site and Alternative Pipeline Route 2, does not offer any significant environmental advantage over the proposed Terminal Site and pipeline.

Terminal Site 4 and Alternative Pipeline Route 3

Terminal Site 4 with Alternative Pipeline Route 3 assumes that Aguirre LLC constructs its offshore terminal at Site 4 using similar construction techniques as for the proposed site. As previously noted, Site 4 does not present any environmental advantage over the proposed site. However, due to concerns regarding the proposed pipeline route, Site 4 with Alternative Pipeline Route 3 could be a reasonable alternative.

From Terminal Site 4, the route alternative is about 4.5 miles (7.2 km) in length, beginning outside of Jobos Bay (MP 0) and extending approximately 0.6 mile (1 km) offshore northeast between Cayo Morrillo and Cayos de Pájaros. The route turns east to follow the existing barge channel across the basin of Jobos Bay to the Aguirre Plant property where it would interconnect with power plant piping (see figure 3.6-1). As currently conceived, 3.9 miles (6.3 km) of this alternative route is directly within the barge channel.

From Terminal Site 4 to the barge channel, construction procedures for installation of the pipeline would be the same as for the proposed route. Once the pipeline enters the barge channel, the pipeline would be installed using hand jetting to establish 4 feet (1.2 m) of cover over the pipeline. Based on Project-specific surveys completed, construction of the pipeline along this alternative route would impact approximately 8.0 acres (8.2 cuerdas) of coral reef habitat, including 3.5 acres (3.6 cuerdas) of consolidated reef and 4.5 acres (4.6 cuerdas) of unconsolidated reef. This is approximately 5.9 acres (6.0 cuerdas) more than the coral reef habitat that would be impacted by the proposed route. One federally threatened species of coral was documented in the reef habitat crossed by the alternative route, while seven protected species were observed along the proposed route.

Alternative Pipeline Route 3 would result in 58.6 acres (60.3 cuerdas) of disturbance, which is about 8 percent greater than the proposed route (54.4 acres [56.0 cuerdas]).

Also, the area crossed by this route alternative would disturb more overall area of coral reef habitat than the proposed route. However, in follow up conversations with NMFS and as indicated in NMFS' September 25, 2014 letter, it was noted that the coral reef areas near to shore were of lower quality than the coral reef areas located further from shore. Further, NMFS' September 25, 2014 letter noted that the benthic surveys indicated that the pass between Cayo Morrillo and Cayos de Pájaros contain less coral and a sand channel where the pipeline could be placed between reef areas. Therefore, although the overall temporary acreage of impact on the coral reef habitat is greater along Alternative Pipeline Route 3 than the proposed route, the impact on the coral species would be greater along the proposed route because of the higher quality of coral reef in the Boca del Infierno pass.

As previously mentioned, Alternative Pipeline Route 3 passes between Cayo Morrillo and Cayos de Pájaros, potentially impacting the recreational uses and commercial uses in this area temporarily during construction. As stated in the description of Terminal Site 4, the area around these cays is used intensively for recreational and commercial uses. Siting the offshore terminal at this location would create permanent impacts on recreational users and marine traffic. Boaters would be required to traverse to the north of the cay or further to the south to avoid the USCG safety zone. This terminal site alternative would also increase the visual impacts on the region, as this site is approximately 1.5 miles (2.4 km) closer to the mainland than the proposed site.

For the reasons related to Terminal Site 4, we conclude that Terminal Site 4 with Alternative Pipeline Route 3 does not present any significant environmental advantages compared to the proposed Project.

Terminal Site 4 and Alternative Pipeline Route 4

Terminal Site 4 with Alternative Pipeline Route 4 assumes that Aguirre LLC constructs its offshore terminal at Site 4 using similar construction techniques as for the proposed site. From Site 4, the route alternative proceeds to the southeast offshore of Cayos de Pájaros and turns northeast between Cayos de Pájaros and Cayos de Barca for a total of 1.6 miles (2.6 km). The route then turns east to follow the existing barge channel across the basin of Jobos Bay to the Aguirre Plant property for about 3.2 miles (5.1 km), where the pipeline would interconnect with power plant piping (see figure 3.6-1). This alternative would require about 4.7 miles (7.6 km) of pipeline.

From the terminal to the barge channel, construction procedures for installation of the pipeline would be the same as for the proposed route. Once the pipeline is in the barge channel, the pipeline would be installed using hand jetting to obtain 4 feet (1.2 m) of cover over the top of the pipe. However, the section of pipeline crossing the coral reef habitat between Cayos de Pájaros and Cayos de Barca would not be buried but would be covered with concrete mats to achieve equivalent protection.

Based on Project-specific surveys completed, construction of the pipeline along this alternative route would impact approximately 12.3 acres (12.6 cuerdas) of coral reef habitat, including 6.2 acres (6.3 cuerdas) of consolidated reef and 6.1 acres (6.3 cuerdas) of unconsolidated reef. This is approximately 10.2 acres (10.4 cuerdas) more than the coral reef habitat that would be impacted by the proposed route. Six federally threatened species of coral were documented in the reef habitat crossed by the alternative route, while seven protected species were observed along the proposed route.

Alternative Pipeline Route 4 is 0.7 mile (1.4 km) longer than the proposed route, and Alternative Pipeline Route 4 would result in 71.8 acres (73.9 cuerdas) of disturbance compared to 54.4 acres (56.0 cuerdas) of the proposed route.

In addition to the coral reef impact, Alternative Pipeline Route 4 passes near Cayos de Pájaros creating a temporary impact on the recreational uses and commercial uses of the offshore area during construction, similar to the proposed route. As previously discussed, Alternative Site 4 would cause permanent impacts on recreational and commercial activities because the USCG safety zone surrounding the facility would limit non-project use of the area. In addition, Alternative Site 4 would result in greater permanent visual impacts on the Las Mareas and shoreline region compared to the proposed site, as detailed earlier in the description of Alternative Site 4.

For the reasons presented above, we conclude that Alternative Terminal Site 4 with Alternative Pipeline Route 4 does not present any significant environmental advantages compared to the proposed Project.

Terminal Site 3 and Alternative Pipeline Route 5

Terminal Site 3 with Alternative Pipeline Route 5 assumes that Aguirre LLC constructs its offshore terminal at Site 3 using similar construction techniques as for the proposed site. From Terminal Site 3, the route alternative proceeds to the northwest offshore of Cayos de Barca and turns northeast between Cayos de Pájaros and Cayos de Barca for a total of 2.1 miles (3.4 km). The route then turns east to follow the existing barge channel across the basin of Jobos Bay to the Aguirre Plant property for about 3.2 miles (5.1 km), where the pipeline would interconnect with power plant piping (see figure 3.6-1). This alternative would require about 5.3 miles (8.5 km) of pipeline.

From the terminal to the barge channel, construction procedures for installation of the pipeline would be the same as for the proposed route. Once the pipeline is in the barge channel, the pipeline would be installed using hand jetting to obtain 4 feet (1.2 m) of cover over the top of the pipe.

Based on Project-specific surveys completed, construction of the pipeline along this alternative route would impact approximately 12.6 acres (13.0 cuerdas) of coral reef habitat, including 6.5 acres (6.7 cuerdas) of consolidated reef and 6.1 acres (6.3 cuerdas) of unconsolidated reef. This is approximately 10.5 acres (10.8 cuerdas) more than the coral reef habitat that would be impacted by the proposed route. Five federally threatened species of coral were documented in the reef habitat crossed by the alternative route, while seven protected species were observed along the proposed route.

Similarly, Alternative Pipeline Route 5 is 1.3 miles (2.3 km) longer than the proposed route. A key criterion in route selection is the reasonably shortest route possible. This Alternative Route would result in 74.9 acres (77.2 cuerdas) of disturbance, which is about 38 percent more than the proposed route (54.4 acres [56.0 cuerdas]).

In addition to the coral reef impact, Alternative Pipeline Route 5 passes near and between Cayos de Pájaros and Cayos de Barca, potentially impacting the recreational uses and commercial uses discussed previously. Adding to these impacts, installing the terminal at Site 3 would further restrict recreational and commercial uses in the area to avoid the USCG safety zone. Finally, this terminal site alternative would introduce comparatively greater visual impacts on the region compared to the proposed site, as detailed earlier in the description of Alternative Site 3.

For the reasons presented above, we conclude that Terminal Site 3 with Alternative Pipeline Route 5 does not present significant environmental advantages compared to the proposed Project.

Proposed Terminal Site and Alternative Route 6

In our review of the Proposed Site and Alternative Route 1 and considering the comments received in NMFS' September 25, 2014 letter on Alternative Route 3, we analyzed a variation of the offshore portion of Alternative Route 1 and present it here as Alternative Route 6 (see figure 3.6-3 and table 3.6-1) This alternative would use the proposed Terminal Site and would use a pipeline route that is 7.4 miles (11.9 km) in length, beginning at the proposed terminal (MP 0.0) and extending approximately 3.4 miles (5.5 km) offshore in a northwest direction before turning northeast of Cayos de Pájaros. The route then follows the existing barge channel across Jobos Bay to the Aguirre Plant. Construction procedures for installation of the pipeline in open water outside Jobos Bay (between about MPs 0.0 and 3.4) would be the same as for the proposed route (direct lay with concrete mats in coral reef areas and buried to below grade or 3 feet (0.9 m)of cover depending on the water depth). The remaining 4.0 miles (6.4 km) would be within the barge channel, where hand jetting would occur to bury the pipe to obtain 4 feet (1.2 m) of cover over the pipeline.

As previously noted, there is a large patch of consolidated coral reef to the northwest of the proposed terminal site. Alternative Routes 1, 2, and 5 cross the reef patch. NMFS noted that these reefs located closer to the mainland had less value than reefs located further offshore. Current routing of Alternative Route 1 crosses a majority of coral reef offshore, as shown in figure 3.6-2. In our review we determined that within the requested 40-foot (12.2 m) wide workspace there is sufficient room to shift the alternative route to the north and avoid a majority of the reef area. In addition, prior to entering the barge channel, the route could be shifted approximately 10 feet (3 m) to the west in order to avoid the coral reef area to the extent possible. This route shift could also apply to Alternative Routes 2 and 5. However, we did not consider this variation for Alternative Route 5 because of the recreational impacts associated with alternative Terminal Site 3, where this route originates. Similarly, we did not consider this variation for Alternative Route 2 because the route passes between Cayos de Pájaros and Cayos de Barca, which contains a higher density of coral reef than the pass between Cayos de Pájaros and Cayo Morrillo, thereby resulting in greater impacts on coral species than Alternative Route 6.

Figure 3.6-3
Site Location Alternatives 1 and 6
Aguirre Offshore GasPort Project

Based on Project-specific surveys completed, construction of the pipeline along this alternative route would impact about 1.9 acres (2.0 cuerdas) of coral reef habitat, including 0.4 acre (0.4 cuerdas) of consolidated reef and 1.5 acres (1.6 cuerdas) of unconsolidated reef (see figure 3.6-4 and table 3.6-3). This is about 0.2 acre (0.2 cuerdas) less than the coral reef habitat that would be impacted by the proposed route. The alternative route would impact approximately 9.3 acres (9.7 cuerdas) of SAV, which is less than the 32.0 acres (32.9 cuerdas) of SAV that would be impacted by the proposed route. However, total impacts of this alternative would be 85.2 acres (87.8 cuerdas), as compared to 54.4 acres (56.0 cuerdas) of the proposed route (see figure 3.6-4).

TABLE 3.6-3

Comparison of Proposed Action and Alternative Route 6 for the Aguirre Offshore GasPort Project

Selection Criteria	Proposed Route	Alternative Route 6
Pipeline Crossing Length (miles [km])		
Consolidated Reef	0.3 (0.5)	0.1 (0.2)
Unconsolidated Reef	<0.1 (<0.1)	0.3 (0.4)
Seagrass	0.9 (1.5)	<0.1 (0.1)
Macroalgea	1.4 (2.1)	1.0 (1.6)
Sand/Mud	1.4 (2.1)	6.0 (9.6)
Temporary Impacts (acres [cuerdas])		
Consolidated Reef	0.9 (0.9)	0.4 (0.4)
Unconsolidated Reef	1.2 (1.3)	1.5 (1.6)
Seagrass	10.6 (10.9)	0.0 (0.0)
Macroalgea	21.4 (22.0)	9.3 (9.7)
Sand/Mud	20.3 (20.8)	74.0 (76.1)
Permanent Impacts (acres [cuerdas])		
Consolidated Reef	0.3 (0.3)	0.1 (0.1)
Unconsolidated Reef	<0.1 (<0.1)	0.3 (0.3)
Seagrass	<0.1 (<0.1)	0.0 (0.0)
Macroalgea	<0.1 (<0.1)	0.0 (0.0)
Sand/Mud	0.2 (0.2)	0.3 (0.3)
Number of Federally Listed Coral Species Impacted	7	2

As mentioned previously, Alternative Route 6 would impact about 0.2 acre (0. 2 cuerda) less coral reef habitat than the proposed route. Although this difference in acreage impacts does not appear to be substantial, what is important to note is the difference in consolidated reef. As shown in table 3.6-3, the temporary impacts on consolidated reef along the proposed route would be 0.9 acre (0.9 cuerda); whereas, 0.4 acre (0.4 cuerda) would be temporarily impacted along this alternative route, resulting in a more than 50 percent reduction in temporary impacts on consolidated reef. Further, the majority of the permanent impacts along the proposed route are on consolidated reef (0.3 acre [0.3 cuerda]). Conversely, an equal amount of permanent acreage impacts are primarily on unconsolidated reef along the alternative route. In terms of length of pipeline, Alternative Route 6 is about 3.4 miles (5.7 km) longer than the proposed route, but table 3.6-3 shows that about 80 percent (6.0 miles [9.6 km]) of this route crosses sand/mud (in the barge channel). Finally, table 3.6-3 shows that two federally threatened species of coral were documented in the reef habitat crossed by the alternative route, while seven species were observed along the proposed route (see table 3.6-3).

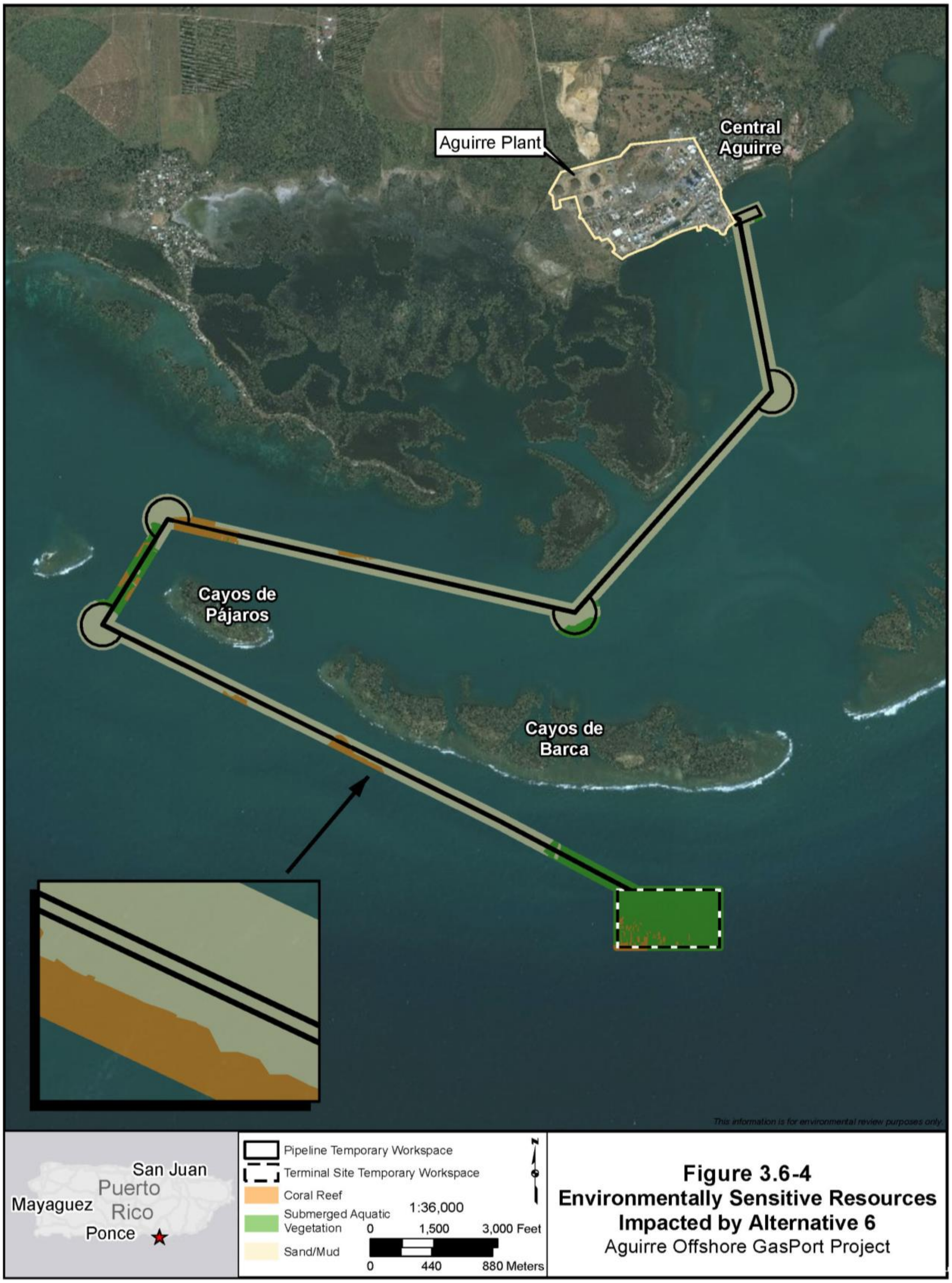

Figure 3.6-4
Environmentally Sensitive Resources Impacted by Alternative 6
Aguirre Offshore GasPort Project

Although Alternative Route 6 is 3.4 miles (5.5 km) longer than the proposed route, it would decrease the impacts on coral reef and seagrass and provide the Project with a reasonable environmentally preferable route. However, as previously noted, the proposed route would be an environmentally acceptable route if it includes the HDD construction method through the Boca del Infierno pass, avoiding impacts on the coral reef and federally listed coral species. We are recommending in section 4.5.2.4 that Aguirre use an HDD to cross the Boca del Infierno pass if it is determined to be a viable construction method. Nevertheless, if the HDD geotechnical analysis were to indicate that a successful drill of the reef located at the Boca del Infierno pass is an unreasonably high risk, the proposed terminal site and Alternative Route 6 would be the environmentally preferable action. Therefore, **we recommend that:**

- **If the HDD is not considered a viable construction method, Aguirre LLC should use Alternative Route 6 to connect the Offshore GasPort to the Aguirre Plant.**

If Alternative Route 6 is authorized, Aguirre LLC would need to address the applicable environmental conditions recommended throughout this EIS and summarized in section 5.2 such that they would address the revised routing.

3.7 PIPELINE ROUTE VARIATIONS FROM THE PROPOSED TERMINAL SITE

Route variations differ from route alternatives in that they are typically shorter in length and do not deviate as far from the propose route as route alternatives, and they are identified to resolve or reduce construction impacts on localized, specific resources such as cultural resource sites, wetlands, recreational lands, residences, landowner requests, and terrain conditions. Because route variations are identified in response to local concerns, they are often the result of landowner comments and may not always clearly display an environmental advantage other than reducing or avoiding impacts on specific features. We have considered a variety of factors in evaluating route variations for the proposed Project, including length, land requirements, resources crossed, and potential for reducing or minimizing resource impacts.

We reviewed three pipeline route variations from the proposed terminal site to the Aguirre Plant. Each of the three route variations was reviewed to determine if a route that was shorter or crossed fewer sensitive resources could be identified. For each route variation, we considered the pipeline length, number of bends in the pipeline, disturbance of SAV (e.g., seagrasses, macroalgae) and coral reef habitat, and direct landfall to the Aguirre Plant. Table 3.7-1 compares the proposed route to the three pipeline route variations (see also figure 3.7-1).

TABLE 3.7-1

Pipeline Route Variations from the Proposed Terminal Site for the Aguirre Offshore Gas Port Project

Route from Proposed Terminal	Offshore Pipeline Length (miles [km])	Sensitive Habitat Crossed [a]	Commentary
Proposed Route	4.0 (6.4)	0.73 mile (1.2 km) of SAV 0.37 mile (0.6 km) of coral reef habitat	
Route Variation 1	4.1 (6.6)	0.96 mile (1.5 km) of SAV 0.43 mile (0.7 km) of coral reef habitat	Similar impacts to proposed route; no advantage to constructing route variation 1.
Route Variation 2	4.1 (6.6)	0.93 mile (1.5 km) of SAV 0.39 mile (0.6 km) of coral reef habitat	Crosses additional areas of coral reef habitat; no advantage to constructing route variation 2.
Route Variation 3	3.9 (6.3)	0.76 mile (1.2 km) of SAV 0.36 mile (0.6 km) of coral reef habitat	Shorter route than proposed; one less bend in the pipe; but based on habitat crossed, no environmental advantage to constructing route variation 3.

[a] Based on Whitall et al., 2011.

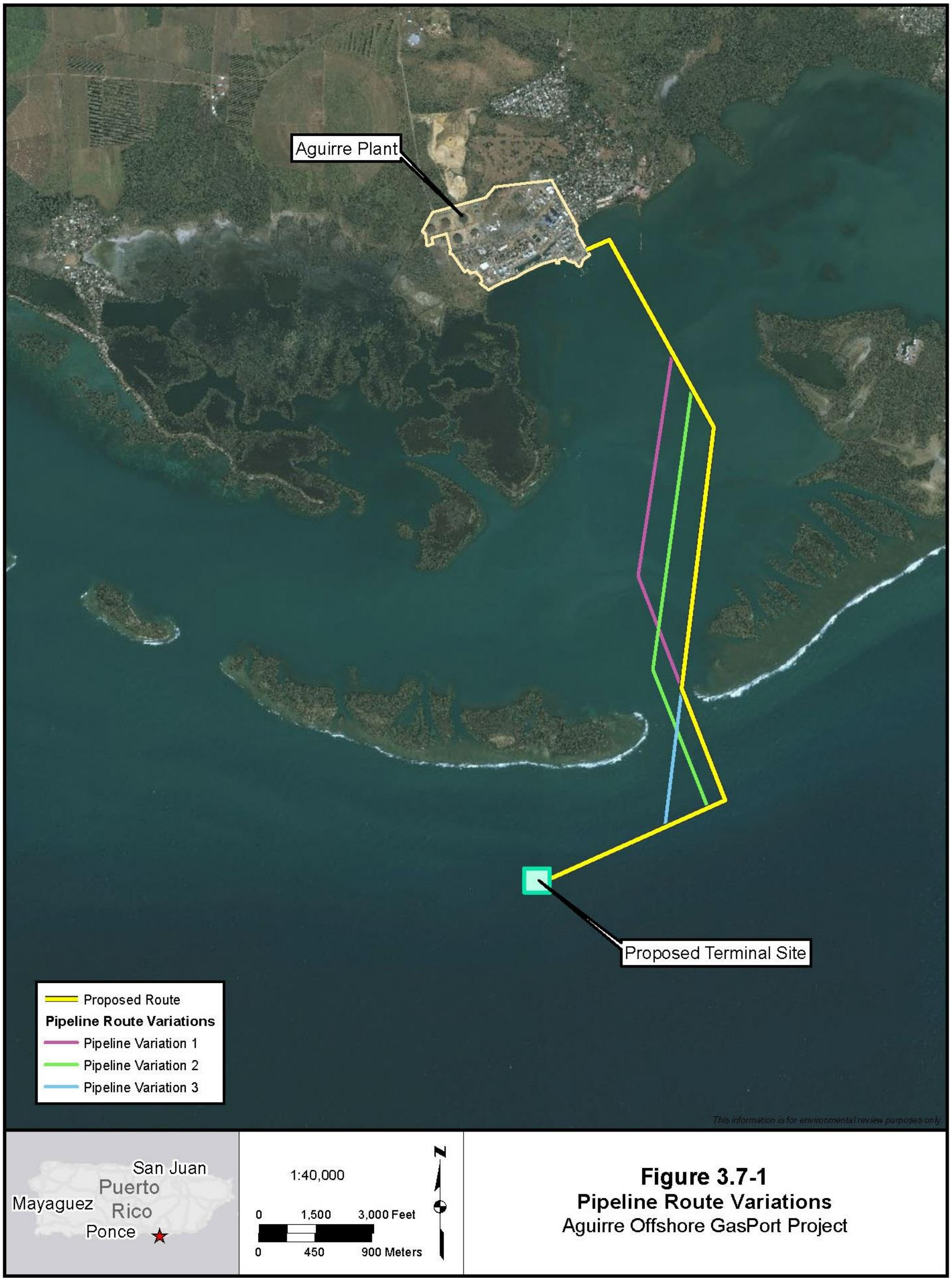

Figure 3.7-1
Pipeline Route Variations
Aguirre Offshore GasPort Project

Following review of the pipeline route variations from the proposed terminal, no one variation provided any greater protection to the environment compared to the proposed route. The proposed route does impact coral reef habitat as well as SAV; however, Aguirre LLC has proposed mitigation that would reduce these impacts (see section 4.5). However, we are recommending that Aguirre LLC construct the pipeline using the HDD construction method or avoid the reef area by constructing Alternative Route 6. Therefore, we conclude that none of the route variations identified would provide significant environmental advantages over the proposed Project route and were not evaluated further.

3.8 LNG VAPORIZATION ALTERNATIVES

There are three available heating methods used to vaporize the LNG: burning part of the vaporized LNG, using the surrounding seawater to warm the LNG, or using the surrounding air to warm the LNG. Any of these warming media can be used directly to warm LNG or can warm an intermediate fluid that then warms the LNG. Burning part of the LNG and no use of ambient seawater is generally referred to as a closed-loop system. Using the surrounding seawater in a once-through system to warm the LNG is generally referred to as an open-loop system. Using ambient air to warm LNG is referred to generally as ambient air vaporization. There are several commercially tested vaporization systems currently used as heat exchangers to vaporize LNG: submerged combustion vaporizers, shell-and tube vaporizers, open rack vaporizers, and ambient air vaporization equipment with or without backup heating systems (usually submerged combustion vaporizers). Vaporization systems can be configured in numerous ways to use one or more of the available heat sources to vaporize LNG.

The Project's objectives were to diversify the energy sources at the Aguirre Plant, thereby reducing the use of fuel oil on the island. Aguirre solicited proposals to provide natural gas to its plant, conducted a review of the proposals and selected Aguirre LLC as its provider. The vaporization system for this project is tied to the type of ship that Excelerate would provide to the project. Excelerate committed to a closed loop system as explained above. The NMFS and Comite Dialogo Ambiental commented on the draft EIS on the vaporization selection. Their comments noted that alternative closed-loop vaporization technologies could reduce the environmental impacts and costs. In the closed-loop mode, steam from the FSRU propulsion steam boilers is used to heat fresh water circulated through the shell-and-tube vaporizers to regasify the LNG. There is no seawater intake or discharge used specifically for the regasification process in the closed-loop mode. The closed-loop mode is preferred by federal and state regulatory agencies due to reduced entrainment impacts. No further review of alternative gasification systems was conducted, however the following information is provided to demonstrate that the vaporization technology presented is comparable and reasonable.

There are five potential vaporizer technologies that were evaluated for the proposed Aguirre Offshore Gasport Project, as shown in table 3.8-1. For comparison purposes each technology was compared by facility requirements, seawater requirements, and air emissions.

The proposed vaporizer facilities would require adequate space on the deck of the ship and energy to power the system. Each of the five potential vaporizer systems uses a significant amount of electricity, with Fan Assisted Vaporization using the most at 46,920 kilowatt (kW), natural gas Submerged Combustion Vaporizers being the lowest at 33,970 kW, and the proposed natural gas Shell and Tube Vaporizers being a close second lowest at 35,400 kW. The two options using natural gas heaters are the lowest in terms of electric usage and the highest in natural gas consumption; however, using natural gas in lieu of seawater would allow the vaporizer to function with no seawater use. In terms of seawater use, the ambient air and natural gas heated technologies require no seawater use, while the seawater heated technologies use between 81,760 gallons per year (309,495 liters) and 104,390 gallons per year (395,159 liters).

TABLE 3.8-1\

Comparison of Alternative LNG Vaporizers for the Aguirre Offshore Gasport Project

	Single Source of Heat				
	Natural Gas Heaters		Seawater		Ambient Air
Comparison Factors	SCV	STV [a]	IFV [b]	STV [c]	FAV [d]
Facility Requirements and Specifications					
Total Facility Power Requirements (kW)	33,970	35,400	37,080	39,200	46,920
Natural Gas Consumed During Facility Operation (MMscfd)	34,750	37,030	1,360	1,863	1,360
Minimum Required Deck Space (square feet) (m^2)	13,024 (1,210)	13,024 (1,210)	12,163 (1,130)	13,024 (1,210)	224,965 (20,900)
Seawater Requirements					
Maximum Daily Seawater Requirements (millions of gallons per day) (millions of m^3 per day)	0 (0)	0 (0)	284 (1.1)	362 (1.4)	0 (0)
Average Daily Seawater Requirements (millions of gallons per day) (millions of m^3 per day)	0 (0)	0 (0)	224 (0.8)	286 (1.1)	0 (0)
Yearly Seawater Requirements (millions of gallons per year) (millions of m^3 per year)	0 (0)	0 (0)	81,760 (309.3)	104,390 (395.2)	0 (0)
Air Emissions [e]					
NO_x (tons per year)	533	562	195	192	217
CO (tons per year)	568	597	237	234	259

[a] Assumes the STVs include natural gas fired process heaters with a water-glycol heating medium in a closed-loop system.

[b] Assumes the IFVs include a propane intermediate fluid that is warmed by seawater. IFVs using a cryogenic Rankine Cycle were not considered.

[c] Assumes the STVs operate with seawater as the heating medium and that the change in the water temperature would be no greater than -13.5 °C (7.5 °F) (based on information provided in the Environmental Assessment for the Gulf Gateway Energy Bridge Deepwater Port; see Docket No. USCG-2003-14294). A larger change in water temperature could potentially involve a risk of freezing and damage to the vaporization equipment.

[d] This analysis assumes that natural gas-fired backup heaters would be necessary for LNG vaporization during periods of cool weather (about 7 percent of the year).

[e] Air emissions are from operation of the vaporization equipment and the electric generators at the LNG Terminal.

SCV	Submerged Combustion Vaporizers	kW	kilowatt
STV	Shell and Tube Vaporizers	MMscfd	million standard cubic feet per day
IFV	Intermediate Fluid Vaporizers	m^3	cubic meters
FAV	Forced Air Vaporization	NO_x	nitrogen oxides
		CO	carbon monoxide

The natural gas and sea water systems had similar deck space requirements at between 1,130 and 1,210 cubic meters (m^3) but the ambient air heated Fan Assisted Vaporization was far larger at 22,900 m^3. Since the size of the ambient air Fan Assisted Vaporization is magnitudes larger than the other technologies, it is not a candidate for the Project due to the ship's limited deck space. The five technologies were also compared based on air emissions. The natural gas heated facilities produces more carbon monoxide and nitrogen oxides than the seawater and ambient air heated technologies.

The conclusion of this analysis found that the natural gas and seawater heated technologies were superior to the ambient air Fan Assisted Vaporization's size which makes ambient air Fan Assisted Vaporization a non-candidate for the facility. The natural gas and the seawater heated technologies were all close in terms of energy usage and size; however, each was superior in one of the other two categories, seawater usage and air emissions.

Seawater Useage

A comment was made by NMFS which stated that two different LNG import projects, Calypso LNG Deepwater Port and Port Dolphin, would use less seawater than the Project and therefore alternatives should be considered which use less water than the proposed method. The Calypso LNG Deepwater Port and Port Dolphin projects would use a closed-loop shell and tube vaporization method that has a water/glycol medium to warm the LNG during the vaporization process. The following table identifies the water usage that was presented in the EIS.

TABLE 3.8-2

Comparison of Seawater Use for Different LNG Projects

LNG Project Name	Calypso LNG Deepwater Port	Port Dolphin	Aguirre Offshore GasPort Project
Closed-Loop LNG Vaporization Method	Shell and Tube with water/glycol intermediate medium	Shell and Tube with water/glycol intermediate medium	Shell and Tube with steam only
Average Daily Seawater Intake	43.2 mgd	23.7 mgd	56.0 mgd

The Project would use a closed-loop shell and tube vaporization method that has only steam to warm the LNG. The use of the water/glycol system allows the waste heat from the diesel generator cooling system to be absorbed by the water/glycol circuit following its exit from the LNG heat exchanger (USCG, 2007). Aguirre LLC uses only steam from its boilers and there is no glycol/water medium to absorb waste heat from the diesel generators. Therefore, the non-glycol/water system used by the Project requires more seawater to cool the diesel generators, since the glycol/water mix is not absorbing any heat form the generators. As a result of this different system, Calypso LNG Deepwater Port and Port Dolphin uses less seawater to cool their diesel generators than the Project. The additional equipment required for the glycol/water system would be difficult to include on the ship deck footprint. Aguirre LLC proposes to use an existing constructed ship, changing the vaporization method of the FSRU is not reasonable considering the location of the facility. Further, because the FSRU is a non-FERC jurisdictional facility, the use of an alternative shell and tube vaporization method that uses the water/glycol closed-loop system is out of the scope of this EIS.

4.0 ENVIRONMENTAL ANALYSIS

4.1 GEOLOGIC RESOURCES

4.1.1 Physiographic and Geologic Setting

Puerto Rico is at the eastern end of the Greater Antilles island chain that runs from Cuba to the Virgin Islands along the northern margin of the Caribbean Sea (see figure 4.1.1-1). This 3,514 square mile (mi^2) (9,101 square kilometer [km^2]) island consists of mainly mountainous terrain with lowland areas along the coasts. An east-west trending mountain chain called the Cordillera Central divides the island and has peaks up to approximately 4,200 feet (1,280 m) in elevation. The major geologic units on the island consist of Jurassic to Eocene volcanic, volcaniclastic, and plutonic rocks, which are overlain by younger Oligocene to recent-aged carbonates and other sedimentary rocks.

Coastal plains formed by erosion of the Cordillera Central make up much of the island's coastal zone. The central south coast of Puerto Rico consists of a series of Pleistocene-age fan deltas formed by erosion, transport, and deposition of terrigenous sediment from rivers flowing from the mountains into a series of seaward-sloping, fan-shaped deposits. The fan deltas in the region of Jobos Bay were formed by flow of the Rio Seco and the Rio Nigua over bedrock of Cretaceous to early Paleogene-age (Renken et al., 2002). Most of the land surface of these south coast fan deposits is less than 164 feet (60 m) above sea level and slopes gently seaward (Renken et al., 2002). The coastal fringes of these fan deltas are typically made up of beach deposits, mangrove swamps, marsh, or scrub flats where protected by offshore fringing reefs.

The nearshore bathymetry along the southern coast of Puerto Rico is dominated by an extensive insular shelf that extends outwards more than 9 miles (14.5 km) in some areas. The shelf provides for shallow nearshore waters that abruptly increase to over 1,500 feet (457 m) deep, seaward of the shelf break (NOAA, 2013a). The Project facilities would be well within the insular shelf with water depths ranging from approximately 60 feet (18 m) near the Offshore GasPort site to 8 feet (2.5 m) near landfall at the Aguirre Plant. Water depths along the majority of the subsea pipeline range from 10 to 25 feet (3 to 8 m).

4.1.2 Mineral Resources

The predominant mineral resources in Puerto Rico include stone, lime, salt, and common clay. In 2009, Puerto Rico's nonfuel raw mineral production was valued at $72 million, which is $26 million less than the 2008 value (U.S. Geological Survey [USGS], 2009a). Based on a review of USGS topographic maps, recent aerial photography, and available USGS databases, no active mining operations are within 0.5 mile (0.8 km) of the onshore portion of the Project (USGS, 2005a; USGS, 2005b).

As a result of past and current construction activities, onshore sources of sand and gravel in Puerto Rico are limited. Based on reconnaissance geologic mapping conducted by the USGS, three offshore sand and gravel deposits were identified on the insular shelf of Puerto Rico. The closest deposit is located off the northwest corner of the Island of Vieques, approximately 40 miles (64 km) east of the Project area (Rodriguez, 2003).

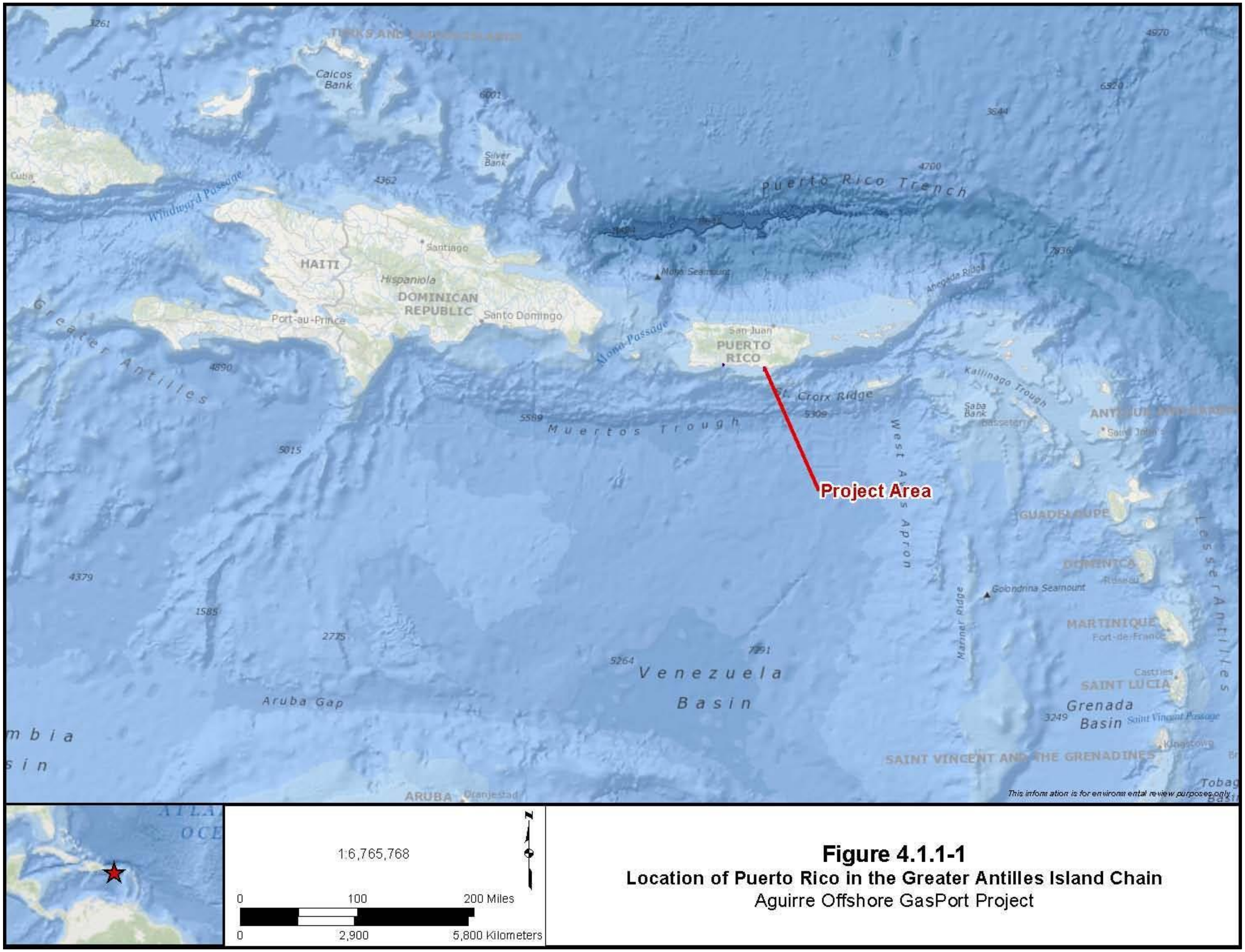

Figure 4.1.1-1

Location of Puerto Rico in the Greater Antilles Island Chain

Aguirre Offshore GasPort Project

4.1.3 Geologic and Other Natural Hazards

Geologic hazards are natural, physical conditions or events that can result in damage to land and structures or injury to people. The geologic hazards examined for the Project include seismicity, fault offsets, liquefaction, tsunamis, volcanic eruptions, and karst terrain. Other natural hazards examined include hurricane winds and waves. Aguirre LLC has investigated the potential hazards in the Project area and has proposed associated design features and mitigation measures (discussed below) that would be implemented to minimize or avoid impacts.

4.1.3.1 Seismicity

Puerto Rico is located along the northern edge of the Caribbean tectonic plate, which encompasses much of Central America and the Greater and Lesser Antilles. The Caribbean plate is sandwiched between the North and South American plates to the north, south, and east, and the Cocos and Nazca plates to the west. The Caribbean plate moves eastward relative to the North and South American plates (Jansma et al., 2000) which results in faulting, earthquakes, and volcanoes along the plate margins. Plate interactions affecting Puerto Rico occur in an approximately 155-mile-wide (250 km) region of deformation between the Puerto Rico Trench to the north of the island and the Muertos Trough to the south (see figure 4.1.3-1). Puerto Rico and the Virgin Islands are situated on a shallow submarine bank within this wide deformational zone (Mueller et al., 2010). The Project area falls within what is known as the Great Southern Puerto Rico Fault Zone, a region of multiple, nearly parallel, faults trending northwest to southeast across the island. Until very recently, these fault zones were considered largely quiescent, although they seemed to be associated with very small earthquakes, and may represent inherited zones of weakness (McCann, 1985).

We received a comment from Captain Jimmy Vazquez-Aran that cited a study performed by the USGS in conjunction with the University of Mayaguez. This study, which could not be located, reportedly identified seismic activity 12 miles (19 km) northeast of the Project between 1986 and 2008. This comment also described how magnitude earthquakes in the 2.3 to 3.0 range would cause strong ground shaking. However, it is not common for magnitude 3 earthquakes to cause strong ground shaking. One of the standards for ground shaking is the Modified Mercalli Scale which shows that Richter magnitudes in the range of 2 to 3 are felt by few people (Michigan Tech, 2007).

We received a comment on the draft EIS from the USGS stating that, based on recent fault investigation studies performed by the Bureau of Reclamation (Reclamation), there may be evidence of faulting that has occurred during the Holocene (past 10,000 to 12,000 years) in the Project area, and should be considered in the geologic hazards for the Project. The fault investigations were conducted for PREPA as part of an assessment of the safety and physical integrity of dams. We subsequently communicated with Reclamation in October 2014 and determined that they had conducted fault investigations of the Salinas and Great Southern Puerto Rico Fault Zone as part of Probabilistic Seismic Hazard Studies (PSHA) for PREPA. These investigations and studies were published internally by Reclamation in May 2014. The fault investigations indicated that Salinas and the Great Southern Puerto Rico Fault Zones were active and should be considered in any probabilistic seismic hazard studies investigations.

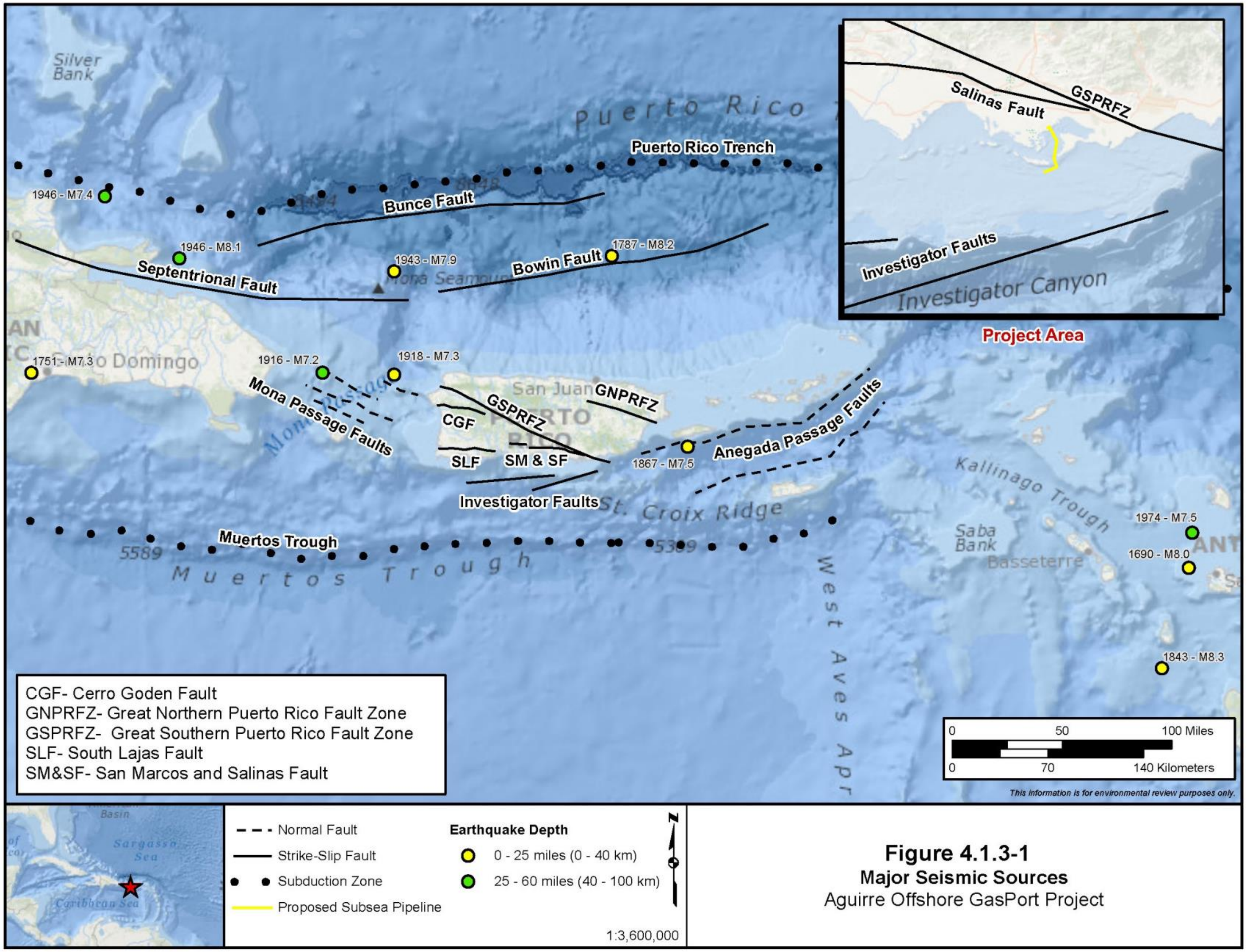

Figure 4.1.3-1
Major Seismic Sources
Aguirre Offshore GasPort Project

Puerto Rico has a long history of damaging earthquakes. At least 12 major earthquakes of magnitude 7.0 or greater have occurred in the Caribbean near Puerto Rico, the U.S. Virgin Islands, and the island of Hispaniola in the past 500 years (Woods Hole Oceanographic Institution, 2005). The closest significant earthquake to the Project area occurred in 1999 approximately 6 miles (10 km) east of the proposed Offshore GasPort. This event had a magnitude of 4.0 and a Modified Mercalli Intensity of VI (USGS, 2009b). An event such as this in the Project area would be felt but would result in little or no damage.

Golder Associates, Inc. (Golder) performed a site-specific probabilistic seismic hazard analysis for the Offshore GasPort site (Golder, 2013b). Golder identified 11 potential seismic sources within about 190 miles (306 km) of the proposed site. The sources are based on Golder's review of the available published data, and reports and maps that describe the tectonics, seismicity, and seismic hazards for the site and surrounding region. Golder's review incorporated the offshore geophysical survey study by C&C Technologies, Inc. (C&C) and included additional literature research. Of the 11 seismic sources, two are subduction zone sources, eight are offshore and onshore crustal faults, and one is a background area source.

Based on the Golder analysis, the potential ground motions at the site are dominated by those sources with largest magnitudes and/or at the closest distances, particularly those with high rates of coseismic slip (i.e., the shortest recurrence intervals for the maximum magnitude events). As shown on figure 4.1.3-1, the dominant seismic sources in the Project area are:

- North American–Caribbean Interface and Interslab Seismic Zone Sources (part of the Puerto Rico Trench Fault Zone)
- Offshore Crustal Faults:
    - Investigator Faults
    - Muertos Trough Fault Zone
    - Anegada Passage Fault Zone
    - Mona Passage Fault Zone
    - Bowin Fault
    - Septentrional Fault
    - Bonce Fault
- Onshore Crustal Faults:
    - Great Northern Puerto Rico Fault Zone
    - Great Southern Puerto Rico Fault Zone
    - Cerro Goden Fault
    - South Lajas Fault
    - San Marcos Fault
    - Salinas Fault
- Crustal Area Source associated with unidentified or buried faults in the upper crust beneath Puerto Rico

It should be noted that the Golder study did not explicitly include the Great Southern Puerto Rico Fault Zone in its seismic source model because trenching studies indicated there was poor evidence of Quaternary surface fault rupture. In addition, the Golder study did not include the Bonce, San Marcos, or Salinas Faults, which were identified in the May 2014 Reclamation investigation discussed above.

The Golder analysis indicated that the primary contribution of the various seismic sources to the probabilistically determined ground motion depended on the level of shaking and spectral acceleration (SA) period of interest. The largest contribution for the peak ground acceleration and 0.2 second spectral acceleration hazard levels of shaking (SA less than 10 percent of gravity) were intraslab events. These accelerations had return periods of less than 100 years. For the intermediate levels of shakings (SA from 10 to 25 percent of gravity) the largest contribution for the peak ground acceleration and 0.2-second spectral acceleration was the Crustal Area Source. These accelerations had return periods from approximately 100 years to 2,500 years. For the highest level of earthquake shaking (SA greater than 25 percent of gravity) the largest contribution for the peak ground acceleration and 0.2-second spectral acceleration hazard was from the Investigator Faults. The Los Muertos Trough and Investigator Faults contributed the largest proportions to the seismic hazard for long period spectral accelerations greater than about 10 percent of gravity.

A Golder geotechnical investigation of the Offshore GasPort site completed during the pre-feasibility design identified areas of loose soils that could be subject to liquefaction during an intense seismic event. Based on these subsurface investigations, the offshore site sediment profile was classified as being Site Class F. American Society of Civil Engineers (ASCE) 7-05 indicates that spectral values for Site Class F should not be taken less than 80 percent of those determined for the same location assuming site coefficients for soil Site Class E.

We received a comment from Captain Jimmy Vazquez-Aran expressing concern over a three-dimensional (3-D) survey of the southern offshore trench conducted by NOAA that reportedly found frequent landslides off of the wall of the southern trench. Earthquakes could thus trigger instability of a subsurface soil layer resulting in landslides off of the trench wall. Aguirre LLC has considered both earthquake ground motions and the potential liquefaction of subsurface layers in the Project design. Aguirre LLC is designing the offshore berthing platform structures assuming that liquefiable soil layers provide no support to the offshore foundation system when subjected to earthquake design forces.

The results of the 2013 Golder Probabilistic Seismic Hazard Studies at the seafloor based on Site Class E are summarized in table 4.1.3-1. The predicted ground motions are consistent with a site with a moderately high seismic hazard.

TABLE 4.1.3-1

Probabilistic Seismic Hazard Analysis Results at Seafloor at Offshore Terminal Site for the Aguirre Offshore GasPort Project

Probability/Return Period	Peak Ground Acceleration (percent of gravity)	Spectral Acceleration at 0.2 Second (percent of gravity)	Spectral Acceleration at 1 Second (percent of gravity)
2 percent in 50 years/2,475 years	35.5	88.7	31.5

Source: Golder and Associates, Inc., 2013a

Golder's Probabilistic Seismic Hazard Analysis (2013a) also investigated the potential for fault offset for the proposed Aguirre LLC facilities. As part of that investigation, a geophysical survey was conducted by C&C at the Offshore GasPort location and along the pipeline route (C&C, 2012). The geophysical data collected by C&C showed no evidence of recent fault offset activity, although one offset in the seafloor below the surface seabed layers potential fault was observed to intersect the pipeline route. Golder also studied reports prepared by others (Rodríquez-Martínez, 2007) and found that no evidence of terrestrial, late Quaternary (Holocene) faulting has been documented along the onshore south coast of Puerto Rico. Evidence of late Quaternary faulting has been reported at three offshore locations, the closest to the area being east of Jobos Bay, which would appear to correspond to strands of the Great

Southern Puerto Rico Fault Zone (Esmeralda and Rio Jueyes faults) continuing their northwest to southeast trend seaward (Mann, 2005). However, this particular seafloor faulting apparently pinches out landward in a scissor-like manner and does not displace terrestrial fan-delta deposits. The Golder report concluded that the overall likelihood of active faults being present along the pipeline route and Offshore GasPort site areas is low based on available geophysical literature and site-specific geophysical data.

We received a comment from Captain Jimmy Vazquez-Aran expressing concern over studies identifying recent deformation of the seafloor along the proposed subsea pipeline route. The geophysical investigation performed by C&C dated July 17, 2013 identified two offsets below the seafloor of which only one intersected the pipeline route; however, there was no visual expression observed in the surface seabed layers or any signs of active fault deformation. Aguirre LLC indicated that in any event, the subsea pipeline would be designed to have the capacity to accommodate a fault offset if it was to occur. Furthermore, the natural gas pipeline would be shut down in the event of a significant earthquake. However, as noted below, we are recommending additional analysis be conducted to further assess the liquefaction potential of the pipeline.

The Golder 2013 Seismic Hazard Study does not explicitly include the Great Southern Puerto Rico Fault Zone and Salinas Faults. Based on the 2014 Reclamation and PSHA studies performed on behalf of PREPA, both Great Southern Puerto Rico Fault Zone and Salinas Fault should be included in the evaluation. Therefore, **we recommend that:**

- **<u>Prior to commencing final design</u>, Aguirre LLC should file with the Secretary of the Commission (Secretary) a revised Seismic Hazard Analysis Report that includes both the Great Southern Puerto Rico and Salinas Faults that is consistent with seismic details of the location and seismic characterization of these faults provided in the May 2014 Reclamation reports. Also, any design and seismic qualification documents that rely upon the current 2013 Golder Seismic Hazard Analysis Report ground motion values should be revised to be consistent with the revised Seismic Hazard Analysis Report.**

4.1.3.2 Liquefaction

Liquefaction is a phenomenon often associated with seismic activity in which saturated, non-cohesive sediments temporarily lose their strength and liquefy (i.e., behave like viscous liquid) when subjected to forces such as intense and prolonged ground shaking. Based on a literature review, no studies of historic liquefaction and liquefaction risk proximate to the Project area were identified. Golder performed an evaluation of potential for and magnitude of earthquake induced liquefaction (Golder, 2013b). Golder indicated that there is the potential for liquefaction to depths approaching 40 feet (12 m) below the seafloor and therefore recommended that liquefaction be assumed in the design of the offshore berthing platform structures. Golder also noted that a more comprehensive analysis was needed to further assess the liquefaction potential of the pipeline. The current pipeline design seems reasonable; however, we agree with this recommendation because the slope angles can have an impact on the pipeline liquefaction potential and they have not been completely evaluated. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Aguirre LLC should file with the Secretary additional studies on the pipeline route seafloor slope angles and the liquefaction potential along the alignment, and provide any necessary mitigation measures based on these studies. These studies should consider the revised seismic design ground motions that explicitly include the Great Southern Puerto Rico and Salinas faults and consider both the Offshore GasPort location and the onshore terminus of the pipeline.**

4.1.3.3 Tsunamis

A tsunami is a set of ocean waves caused by any large, abrupt disturbance of the seafloor. Tsunamis proximate to Puerto Rico are mainly associated with earthquakes. Historic earthquakes around Puerto Rico have occurred north, east, and west of the island, affecting the coasts facing the locations of the earthquakes. The volcanic activity along the Lesser Antilles (see section 4.1.3.4) may also result in tsunamis in the region but would not likely impact the Project area.

Tsunami flood mapping created by the University of Puerto Rico (2011) shows that portions of the Aguirre Plant would likely be inundated if a tsunami occurred. However, the flooding is only estimated to extend approximately 200 feet (61 m) onshore in that area and would not impact the majority of the plant facilities (see figure 4.1.3-2).

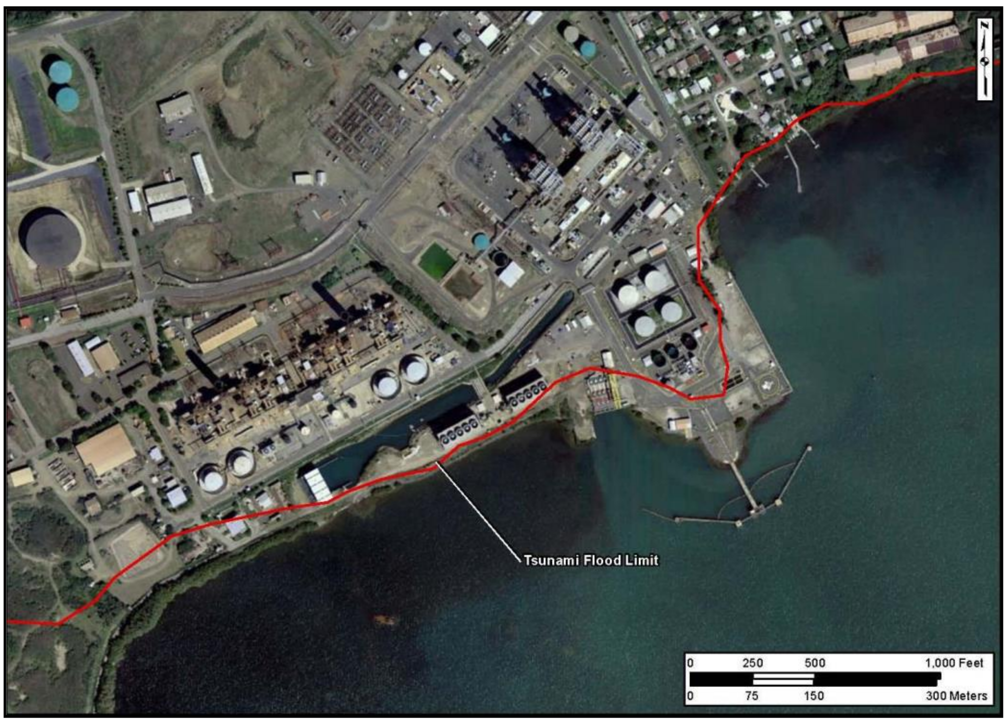

Figure 4.1.3-2 Tsunami Flood Limit

Aguirre LLC investigated the tsunami hazard associated with the Offshore GasPort and onshore facilities. The chance of a tsunami run-up, which is the vertical height above sea level, exceeding 6.6 feet (2 m) within the region is quite unlikely. Aguirre LLC also concluded that for the offshore berthing platform structures the hurricane design waves would be much higher than maximum expected tsunami waves (C&C, 2012). We agree.

4.1.3.4 Volcanic Eruptions

Based on available information, no volcanic activity has occurred in Puerto Rico in the last 10,000 years (USGS, 2013). However, the Lesser Antilles located to the east of Puerto Rico have experienced numerous volcanic events in the last 12,000 years (Boudon et al., 2007). In particular, the Soufriere Hills and Kick’em Jenny volcanos, located approximately 200 miles (322 km) east and 500 miles (805 km) southeast of the Project area, respectively, have experienced volcanic activity in recent history and may be prone to future events. Based on the distance between the Project area and these volcanos, and others along the Lesser Antilles, the likelihood of volcanic activity impacting the Project is very low.

4.1.3.5 Karst Terrain

Karst terrain is characterized by distinctive landforms such as sinkholes, caves, and caverns created from the dissolution of soluble rocks, principally limestone and dolomite. Approximately 20 percent of Puerto Rico, primarily along the north coast, is covered by karst terrain formed on limestone formations (Giusti, 1978). However, karst development on the limestone belt of the south coast has been very limited. The limited development may be due to the aridity of the south coast in comparison to the north coast and/or the presence of caliche on the south coast (Rodríguez-Martinez, 2007). Caliche is a residue created by the evaporation of water saturated with calcium bicarbonate that forms a surficial crust that can be several feet thick, which limits the penetration of water into the soil. Based on the limited development of karst features along the southern coast, the likelihood of the Project facilities crossing any karst terrain is low.

4.1.4 Mitigation Design Features

Aguirre LLC indicated that the design of the offshore berthing platform structures would account for both seismic ground motion and liquefaction effects. The offshore berthing platform structures would be designed for the site-specific Design Earthquake ground motions of ASCE 7-05 which have a PGA of 24 percent of gravity. In addition, Aguirre LLC has developed contingency plans to shut down the terminal, and to move the vessels immediately following a significant earthquake/fault offsets that could possibly rupture the subsea pipeline. Aguirre has also considered tsunami and hurricane effects on the offshore berthing platform. The predicted tsunami wave run-up heights at the terminal are significantly less than those predicted for both a 100- and 500-year return period hurricane storm surge; so the storm surge wave height would govern the design. Also in the event of a threatening hurricane or tsunami, the moored ship(s) would depart and head for deeper water prior to the waves reaching the terminal.

The offshore berthing platform structures would be designed as steel jacketed or tri/quad pile structures that are anchored with steel piles to firm ground below the seafloor liquefiable sediments. The piles would not rely on the potential liquefiable sediments to provide vertical support. Laterally the effects of liquefaction would be considered in the jacket and pile design in combination with lateral seismic forces. The effects of liquefaction on the offshore pipeline have been considered; however, we are recommending in section 4.1.3.2 that Aguirre LLC conduct additional studies to accommodate potential liquefaction induced settlements and lateral spreading.

Aguirre LLC would design the offshore berthing platform structures to withstand wind and wave loadings. The offshore structures would be designed for a wind speed of 68.2 miles per hour (mph) (3-second gust) (109 kilometers per hour [km/hr]) before the vessels disengage and leave the terminal; and designed for approximately 150 mph (241 km/hr) (sustained) and 179 mph (288 km/hr) (3-second gust) after the vessels have departed. Based on preliminary studies performed for Aguirre LLC by Forristall Ocean Engineering Inc. (Forristall), the current estimate of the 500-year wave crest height at the Offshore GasPort site is 46.7 feet (14.2 m) above Lowest Astronomical Tide (Forristall, 2013). The underside of the Offshore GasPort upper deck height is 41.7 feet (12.7 m) above Lowest Astronomical Tide. Because the upper deck would be subject to full wave crest impact effects, the offshore berthing platform structures would be designed to withstand the impact forces from wave loadings based on a hurricane with a 500-year return period. Aguirre LLC has committed to updating the wave studies prior to commencing with detailed design on the offshore berthing platform structures. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Aguirre LLC should file with the Secretary the updated offshore wave analyses as indicated in Aguirre LLC's December 5, 2013 response to the FERC's November 15, 2013 Environmental Information Request (questions 6 and 7). This analysis should be stamped and sealed by the professional engineer-of-record.**

Aguirre LLC would establish a tsunami warning system to ensure that the moored vessels and Offshore GasPort operators can initiate a safe shutdown of the facility to minimize damage that may occur in the event of a tsunami in the region. In the event of a tsunami, the vessels would be released from their moorings to prevent damage caused by the vessels from being pushed into offshore berthing platform structures by waves.

The design of the offshore platform is currently at the Front End Engineering Design (FEED) level of completion. Aguirre LLC has proposed a feasible design and it has committed to conducting a significant amount of detailed design work for the Project if it is authorized by the Commission. Information regarding the development of the final design, as detailed below, would need to be reviewed by FERC staff in order to ensure that the final design addresses the requirements identified in the FEED. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Aguirre LLC should file with the Secretary the following information, stamped and sealed by the professional engineer-of-record:**

  a. offshore berthing platform structures (including prefabricated and field constructed structures) and pile foundation design drawings and calculations. The offshore berthing platform structures and pile foundation designs should incorporate criteria revisions agreed to by Aguirre LLC in its responses to FERC staff's June 17 and November 15, 2013 Environment Information Request;

  b. seismic specifications used in conjunction with the procuring equipment; and

  c. quality control procedures that would be used for design and construction.

Aguirre LLC should file the schedule for producing this information in its Implementation Plan.

Because we recognize the Project area is located in an area of high seismicity, our regulations in 18 CFR 380.12(h)(5)[1] require that a special inspector be contracted by an applicant to observe the work performed to assure the quality and performance of the seismic resisting systems. To ensure these requirements are met, **we recommend that:**

- **<u>During construction</u>, Aguirre LLC should employ a special inspector. The special inspector should be responsible for:**

  a. observing the construction of the offshore berthing platform to be certain it conforms to the design drawings and specifications;

  b. furnishing inspection reports to the engineer or architect of record, and other designated persons. The inspection reports should be summarized in <u>monthly</u> status reports and filed with the Secretary. All discrepancies should be brought to the immediate attention of the contractor for correction, or if uncorrected, to the engineer or architect of record; and

  c. submitting a final signed report stating whether the work requiring special inspection was, to the best of his/her knowledge, in conformance with approved plans and specifications and the applicable workmanship provisions. A copy of the report should be filed with the Secretary.

4.1.5 Paleontological Resources

Paleontological resources are the fossilized remains of prehistoric plants and animals, as well as the impressions left in rock or other materials as indirect evidence of the forms and activities of such organisms. The geologic units underlying the Project area are composed primarily of Quaternary age-unconsolidated deposits that are continuously reworked by tide and wave action. Based on the presence of these recent deposits and the limited disturbance of deeper sediment that would occur as a result of the Project, the possibility of encountering paleontological resources of significance is low.

4.2 SOILS AND SEDIMENTS

4.2.1 Soils

Impact on soils within the Project area would be limited to the 1.5 acres (1.5 cuerdas) required for the onshore temporary staging and support area. This area is within the existing Aguirre Plant property and has been disturbed by past industrial activities. The majority of the Aguirre Plant property, including the Project area, is mapped as Pozo Blanco clay loam, 5 to 12 percent slopes, eroded (Soil Survey Staff, 2013). The Pozo Blanco series consists of very deep, well drained soils that formed in sediments weathered from limestone and calcareous volcanic rocks. These soils are not designated as hydric or considered prime farmland. The main limiting factor for these soils is their susceptibility to erosion by water (Soil Survey Staff, 2013).

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[1] NBSIR84-2833 “Data Requirements for the Seismic Review of LNG Facilities.”

4.2.2 Sediments

Sediment eroded from the land surface within the Jobos Bay watershed is delivered to the bay by surface runoff occurring during rain events. Much of this terrigenous sediment is deposited within the bay and makes up a fraction of the mud and sand on the bay seafloor. The most widespread sediment type is a sandy mud which consists of coarse shell debris mixed with fine grained terrigenous and carbonate mud.

Aguirre LLC conducted geotechnical investigations along the proposed pipeline route and in the area of the Offshore GasPort to characterize subsurface conditions in the Project area. These investigations included 4 shallow (2 to 4 feet [0.6 to 1.2 m]) vibracore samples along the pipeline route and 6 deep (80 to 177 feet [24 to 54 m]) borings outside of Jobos Bay. In addition, side scan sonar, a subbottom profiler, and a shallow seismic boomer system were utilized to interpret the geophysical conditions in the Project area. Figure 4.2.2-1 shows the boring/vibracore locations and interpreted bottom conditions in the Project area.

Sediments in the two shallow borings along the pipeline route that were closest to landfall consisted mostly of very soft, very dark greenish gray silty clay with very fine sand and shell fragments. The vibracore taken further out into Jobos Bay consisted of very dark greenish gray, silty fine sand with shell fragments. The vibracore taken at the mouth of the Bay contained only coarse shell fragments; therefore, detailed sediment analysis was not possible (C&C, 2012).

The deep borings collected outside of Jobos Bay identified three major subsurface units. The upper unit was interpreted to be recent marine deposits and was up to 40 feet (12 m) thick, consisting of very loose to dense sand and very soft, silt, clay, and peat. This unit was underlain by relict reef deposits that were 29 feet (9 m) to more than 46 feet (14 m) thick, consisting of medium to dense sand, dense to very dense gravel, and relict coral reef fragments. The deepest unit was interpreted to be alternating older terrigenous and marine deposits and consisted of loose to very dense sand and gravel and firm to hard silty clay. This unit extended to the bottom of all of the boring except one unit (BH-13), which terminated in the overlying unit (Golder, 2013a).

4.2.2.1 Sediment Contamination

In 2008, NOAA collected samples from 44 locations throughout Jobos Bay to quantify the level of chemical contaminants in the sediments within the bay (Whitall, et al., 2011). Thirteen of these locations were within approximately 1 mile (1.6 km) of the Project area. Samples were analyzed for polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyl congeners (PCBs), organochlorine pesticides (e.g., dichlorodiphenyltrichloroethane [DDT]), butyltins, and metals. Table 4.2.2-1 summarizes the results of these analyses and lists the effects range low (ERL) and effects range median (ERM) threshold values for each contaminant, as established under NOAA National Status and Trends sediment quality guidelines. Concentrations below the ERL are not considered to pose a risk to benthic communities, and concentrations above the ERM are expected to have some degree of negative effect (Long and Morgan, 1990; Long et al., 1996).

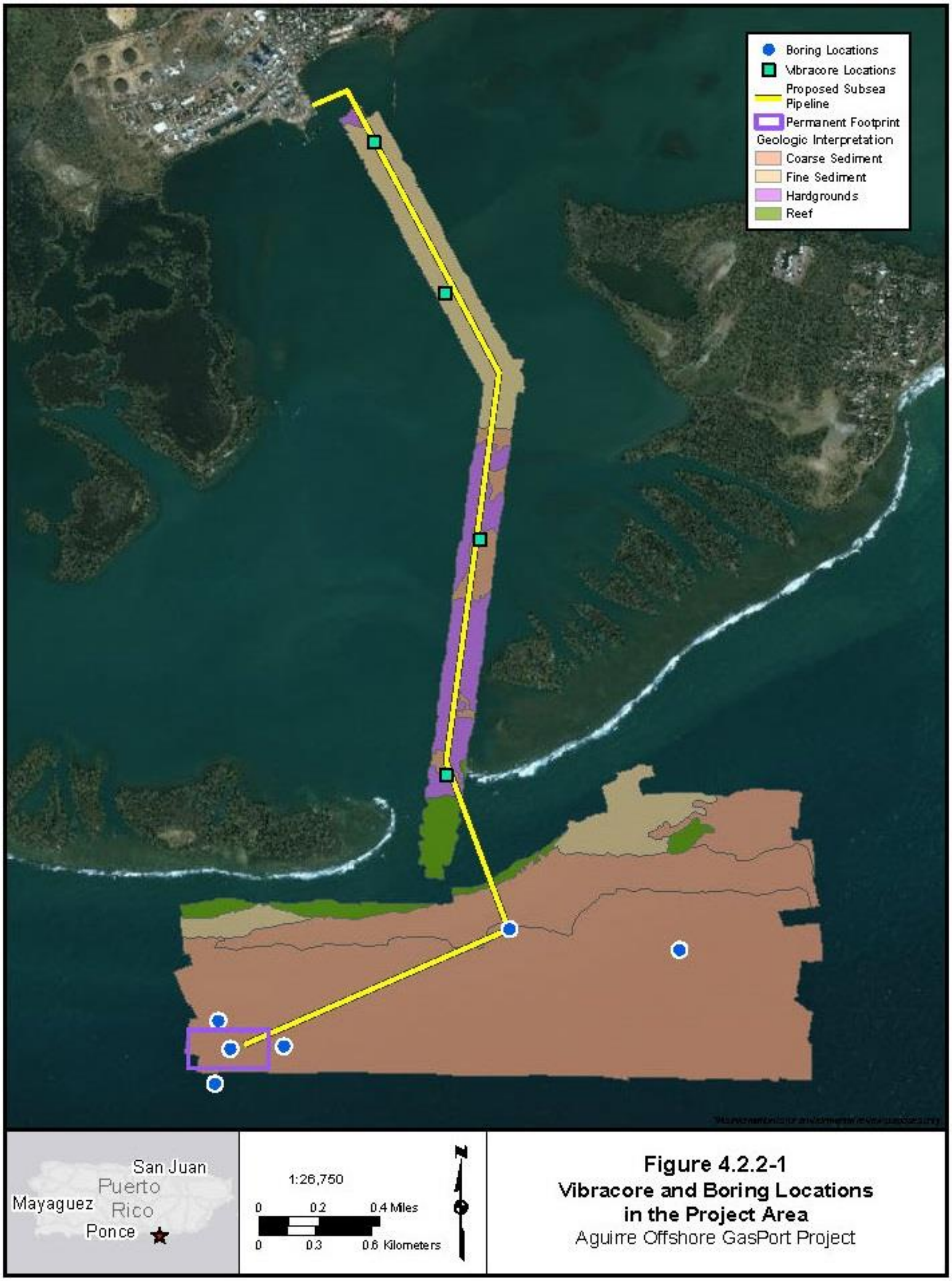

Figure 4.2.2-1
Vibracore and Boring Locations in the Project Area
Aguirre Offshore GasPort Project

TABLE 4.2.2-1

Summary of Analytical Data for Sediment Samples from Jobos Bay (May 2008) for the Aguirre Offshore GasPort Project

Contaminant	ERL (mg/kg)	ERM (mg/kg)	All 44 Sample Locations Minimum (mg/kg)	All 44 Sample Locations Maximum (mg/kg)	All 44 Sample Locations Mean (mg/kg)	13 Locations Within 1 Mile of Project Area Minimum (mg/kg)	13 Locations Within 1 Mile of Project Area Maximum (mg/kg)	13 Locations Within 1 Mile of Project Area Mean (mg/kg)
Total PAHs	4.0	44.8	0.004	14.3	1.1	0.06	3.41	0.66
Total PCBs	0.02	0.18	0.002	0.02	0.004	0.002	0.02	0.005
Total DDT	0.002	0.046	ND	0.003	0.001	ND	0.003	0.001
Tributyltin	NA	NA	ND	0.01	0.001	ND	0.002	0.0
Silver	1.0	3.7	0.05	0.22	0.12	0.05	0.14	0.09
Aluminum	NA	NA	629.0	73,700.0	39,138.0	28300.0	68200.0	45453.3
Arsenic	8.2	70.0	1.8	28.1	12.6	6.9	28.1	14.1
Cadmium	1.2	9.6	ND	0.17	0.008	ND	0.17	0.02
Chromium	81.0	370.0	ND	29.8	18.2	9.4	29.4	20.1
Copper	34.0	270.0	1.4	73.7	33.8	13.1	69.0	34.8
Iron	NA	NA	1,060.0	50,500.0	26,570.0	16600.0	48100.0	29826.7
Mercury	0.15	0.71	0.001	0.14	0.04	0.008	0.10	0.04
Manganese	NA	NA	33.1	1,130.0	510.6	329.0	765.0	590.5
Nickel	20.9	51.6	ND	31.0	11.0	4.4	26.6	11.9
Lead	46.7	NA	0.23	16.7	7.2	2.8	14.0	7.5
Antimony	NA	NA	ND	0.59	0.22	ND	0.56	0.28
Selenium	NA	NA	ND	1.6	0.33	0.11	1.6	0.36
Tin	NA	NA	ND	2.7	1.1	0.57	2.1	1.3
Zinc	150.0	410.0	1.6	117.0	54.2	25.7	117.0	58.8

Source: Whitall et al., 2011

Notes: NA = sediment quality guideline not available; ND= constituent below detection limits; mg/kg = milligram per kilogram

As shown in table 4.2.2-1 none of the samples contained concentrations of contaminants that exceeded the corresponding ERM. However, the ERL was exceeded in at least one sample location for five contaminants (total PAHs, total DDT, arsenic, copper, and nickel). The ERL for total PAHs was exceeded in one sample location, which was approximately 2 miles (3.2 km) east of the Project area. The ERL for total DDT was exceeded in four sample locations, two of which were within 1 mile (1.6 km) of the Project area. The ERL for arsenic was exceeded in 31 of the 44 total sample locations, 12 of which were within 1 mile (1.6 km) of the Project area. The ERL for copper was exceeded in 9 sample locations, 5 of which were within 1 mile (1.6 km) of the Project area. The ERL for nickel was exceeded in 3 sample locations, 3 of which were within 1 mile (1.6 km) of the Project area.

Whitall et al. (2011) observed that the contaminant concentrations observed in Jobos Bay were comparable to other areas of Puerto Rico and were generally below established sediment quality threshold guidelines, suggesting that impacts on resident biota are unlikely. The study recognizes that, whereas PAHs, PCBs, and DDT are derived from anthropogenic sources, the comparability of metal constituent concentrations to those in other coastal areas of Puerto Rico indicates that likely sources in Jobos Bay may include natural bedrock weathering, detrital inputs from tributaries, and atmospheric deposition, more than direct input from locally based industrial sources.

4.2.3 General Impact and Mitigation

4.2.3.1 Soils

Onshore construction and operation activities would be limited to previously disturbed, industrial areas and would not represent new impacts on soils resources. To minimize or avoid impacts associated with the onshore portion of the Project, Aguirre LLC would implement measures outlined in the FERC Plan and Procedures, which includes measures to control erosion and sedimentation (e.g., installation of silt fence) during construction and to ensure proper restoration of disturbed areas following construction.

4.2.3.2 Sediment Resuspension and Transport

Construction activities, including burial of the pipeline and the installation of the piles and permanent structures at the Offshore GasPort, would result in the resuspension of seafloor sediment into the water column. As discussed above, the sediments in the vicinity of the Offshore GasPort consist of mostly sand, which would descend rapidly and deposit on the seafloor near the base of the piling or at the site of the source of disturbance. Currents in this area can exceed 3.3 feet per second (ft/sec) (1.0 m/s) during storms but typically flow westward in the range of 0.2 to 0.3 ft/sec (0.06 to 0.09 m/s).

The amount of sediment resuspension and transport pipeline installation would vary with the length and severity of disturbance, grain size composition, and resettling rates. Based on historical data (NOAA, 2013b), standard currents along the south shore of Puerto Rico, near the City of Ponce, are primarily tidally induced with a maximum ambient speed of about 1.6 ft/sec (4.9 m/s) near the seafloor; however, storm induced currents occasionally exceed 3.0 ft/sec (0.9 m/s) at the same depth. These values can be considered representative of those that could be found in the oceanic waters of the Project area, beyond Jobos Bay. The current speed of 1.6 ft/sec (0.5 m/s) corresponds to a bed stress of 0.00009 psi (0.62 Pascals [Pa]) and a shear velocity of 0.1 ft/sec (0.03 m/s), using a quadratic resistance coefficient of 0.0025.

In Jobos Bay, surface currents average 0.3 ft/sec (0.1 m/s) and range from 0 to 0.9 ft/sec (0 to 0.3 m/s) (Field et al., 2003; Zitello et al., 2008). Currents closer to the seafloor have been measured at speeds up to 0.3 ft/sec (0.1 m/s) in water less than 33 deep (10 m). The maximum current speed of 0.9 ft/sec (0.3 m/s) corresponds to a bed stress of 0.00002 psi (0.14 Pa) and a shear velocity of 0.04 ft/sec (0.01 m/s).

Critical stresses for mobilization of cohesive mixtures of clay, silt, fine sand, and organic matter similar to those in Jobos Bay are approximately 0.00004 to 0.00007 psi (0.28 to 0.48 Pa); the critical stress to mobilize fine to medium 250-micron sand grains is approximately 0.00004 psi (0.28 Pa), whereas coarser sand (1000 microns) has a critical stress of approximately 0.00006 psi (0.41 Pa). On this basis, current speeds in Jobos Bay, which correspond to a bed stress of up to 0.00002 psi (0.14 Pa), would be insufficient to cause widespread sediment mobilization; however, this does not account for the latent ability to transport sediments mobilized by construction activities. Vertical settling rates for suspended substrates vary by particle size, from approximately 16 feet per day (5 m per day) for clay and very fine silt to approximately 16,400 feet per day (5,000 m per day) for coarse sand.

We commissioned a study to predict the suspended sediment concentrations and subsequent transport and deposition resulting from hand jetting/suction activities during the burial of the pipeline. A copy of the study is included as appendix C. The analysis was conducted using the Suspended Sediment FATE (SSFATE) model, which was jointly developed by Applied Science Associates, Inc. and the COE to address short-term movements of resuspended sediments and predicts the path and fate of particles using three-dimensional currents in estuaries and oceans. The results of the analysis are summarized in tables 4.2.3-1 and 4.2.3-2, and illustrated on figures 4.2.3-1 and 4.2.3-2. Maximum suspended sediment concentrations reached 1,620 milligrams per liter (mg/L) in the vicinity of the jetting activities. However, turbidity decreased to 50 mg/L or less within approximately 100 feet (30 m) of a majority of the construction area. Deposition rates were highest along the pipeline, with a maximum deposition of approximately 0.7 inches (1.7 cm), but were reduced to less than 0.04 inch (1 mm) within approximately 200 feet (61 m) of a majority of the construction area. Installation of concrete mats and structural jackets and piles would also cause some sediment resuspension. Based on the limited footprint of these facilities and the installation techniques that would be utilized, little net transport of either suspended or bed load material outside of the construction area would be anticipated. Therefore, sediment transport associated with the installation of the concrete mats and pilings was not included in the analysis.

TABLE 4.2.3-1

Maximum Turbidity Concentrations

Plume Concentration (mg/L)	Total Area (acres [cuerdas])	Area Outside Construction Right-of-Way (acres [cuerdas])	Maximum Distance from Pipeline (feet [m])
5 to 10	204.1 (210.0)	197.9 (203.7)	3,775.5 (1,150.5)
10 to 20	77.9 (80.1)	72.6 (74.7)	1,623.9 (495.0)
20 to 50	71.2 (73.2)	64.5 (66.4)	1,389.5 (423.5)
50 - 100	22.0 (22.6)	18.2 (18.7)	866.9 (264.2)
100 to 200	14.9 (15.3)	12.7 (13.1)	188.7 (57.5)
200 to 500	23.8 (24.5)	19.0 (19.6)	71.4 (21.8)
500 to 1000	28.8 (29.7)	15.8 (16.3)	40.7 (12.4)
1000 to 2000	5.3 (5.4)	0.8 (0.8)	24.5 (7.5)
> 2000	0	0	0

Source: Applied Science Associates, Inc., 2014

TABLE 4.2.3-2

Maximum Sediment Deposition

Accumulation (in [mm])	Total Area (acres [cuerdas])	Area Outside Construction Right-of-Way (acres [cuerdas])	Maximum Distance from Pipeline (feet [m])
0.004 to 0.04 (0.1 to 1)	131.6 (135.4)	107.1 (110.2)	1,115.3 (339.9)
0.04 to 0.08 (1 to 2)	32.8 (33.8)	27.7 (28.5)	257.8 (78.6)
0.08 to 0.16 (2 to 4)	24.3 (25.0)	17.3 (17.8)	170.9 (52.1)
0.16 to 0.24 (4 to 6)	11.9 (12.3)	4.9 (5.1)	113.0 (34.4)
0.24 to 0.32 (6 to 8)	2.6 (2.7)	2.3 (2.4)	83.0 (25.3)
0.32 to 0.39 (8 to 10)	2.1 (2.2)	1.9 (2.0)	60.8 (18.5)
0.39 to 1.97 (10 to 50)	4.8 (5.0)	2.6 (2.7)	50.4 (15.4)
> 1.97 (>50)	0	0	0

Source: Applied Science Associates, Inc., 2014

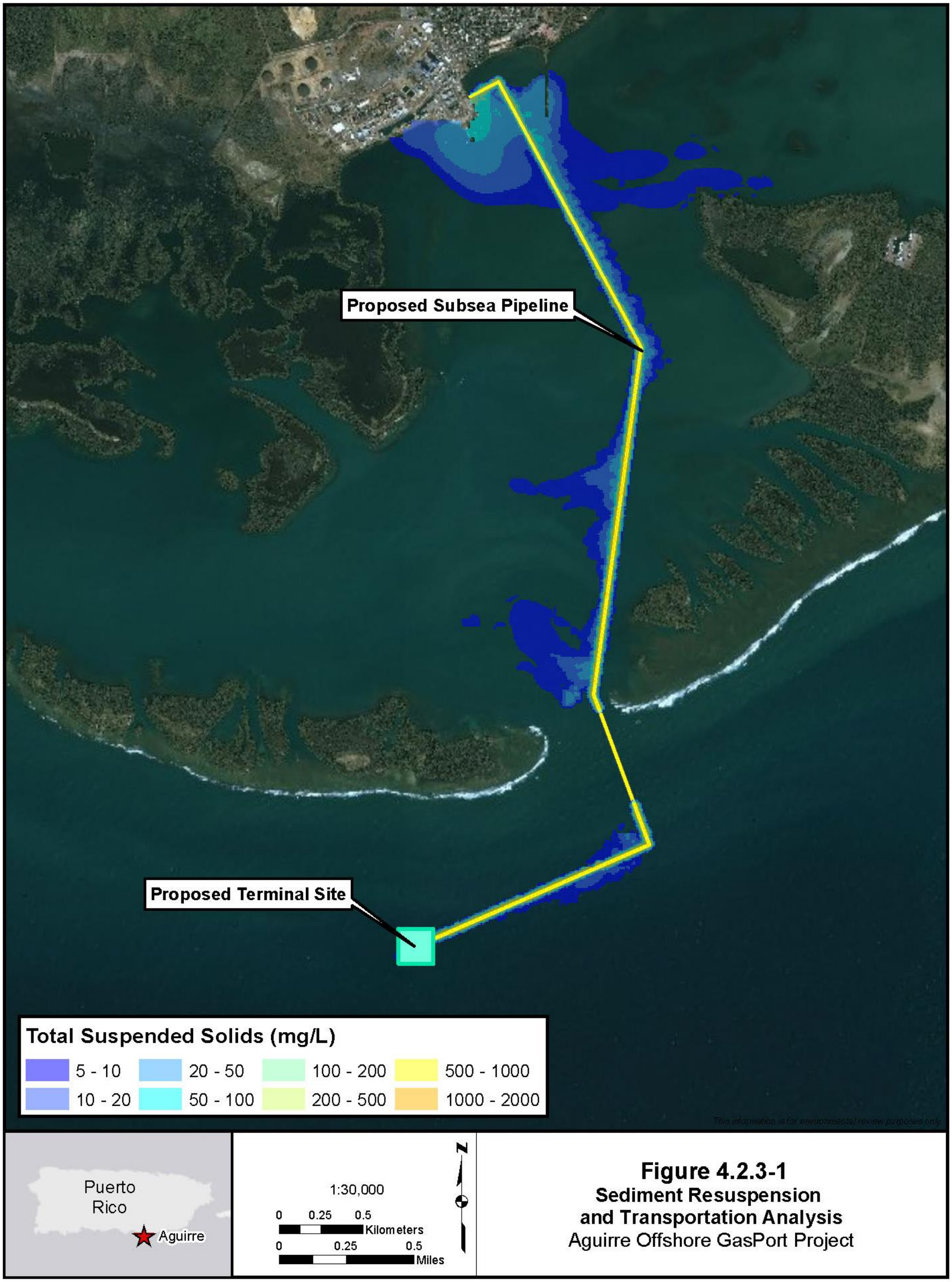

Figure 4.2.3-1
Sediment Resuspension and Transportation Analysis
Aguirre Offshore GasPort Project

Figure 4.2.3-2
Sediment Deposition Analysis
Aguirre Offshore GasPort Project

With the exception of the crossing of the Boca del Infierno pass, the subsea pipeline would be covered with natural sediment as part of the lowering procedures (see section 2.3.4). We anticipate that the standard currents along the seafloor would return the disturbed areas to pre-construction contours shortly after construction is complete. During operations, Aguirre LLC would inspect the subsea pipeline, including a bottom survey, to observe surface conditions on and adjacent to the full pipeline right-of-way for indications of leaks, construction activity, and other factors affecting safety and operation (see section 2.6.4). Aguirre LLC would be required to obtain the appropriate permits or authorizations prior to commencing any maintenance or repair procedures on the subsea pipeline.

During operation of the Offshore GasPort, scouring-induced substrate loss around piles could potentially compromise foundation stability and structural integrity. American Petroleum Institute (API) guidelines (2011) recommend including scour allowances [2] for both global (regional) and localized scour around sleeves/piles and developing those allowances based on site-specific data (metocean and sediment transport studies). However, the guidelines also include a general recommendation of at least 1.5 times the sleeve (jacket) or pile diameter for localized scour. Aguirre LLC is proposing to use a scour allowance of two times the pile diameter (5 feet [1.5 m]) to protect against localized scour. This equates to a scour allowance of 10 feet (3 m). Additionally, steel piles would be coated with a scour-resistant material.

Based on the footprint of the proposed pipeline and Offshore GasPort piles, we conclude that the Project would not have a significant impact on sediments in the area. If a portion of the pipeline is constructed using the HDD technique, sediment resuspension would occur at the HDD entry and exit points; however, these effects would be short-term during construction.

4.2.3.3 Sediment Contamination

As discussed in section 4.2.2.1, low concentrations of contaminants were reported in sediment samples taken proximate to the Project area. Exceedance of the ERL was noted for total PAHs, total DDT, arsenic, copper, and nickel. However, exceedance of the ERL is not considered a definitive basis for negative effects but only as an inferential consideration for potential effects when considered in the context of background concentrations.

Based on the results of the 2008 NOAA study, construction activities in Jobos Bay are not expected to cause widespread or significant impacts associated with the introduction of contaminants into the water column through resuspension of surficial sediments. The existing benthic infaunal community is inevitably exposed to existing contaminants in the surficial sediments and the temporary resuspension of this material is not expected to exacerbate this exposure. Most of the detected contaminants were below the ERL screening value, indicating the absence of an associated significant risk to marine life. Therefore, we conclude that the resuspension of these contaminants during construction would not represent a significant impact on sensitive resources in the area.

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[2] "Scour allowance" is a depth below the seafloor that is disregarded during pile design. Theoretically, it is the depth of benthic substrate that is potentially subject to scouring and, under the worst-case design scenario, assumed to be absent. In other words, pile length (for vertical support) and jacket bracing (for lateral support) would be designed to reflect conditions where this depth of material has been lost through scouring and cannot provide potential foundation support. This design procedure does not minimize scour; rather it mitigates against scour effects.

4.3 WATER RESOURCES

4.3.1 Offshore Surface Water Resources

4.3.1.1 Physical Oceanography

As discussed in section 2.1, Aguirre LLC would construct the Project offshore of Salinas, along the southern shore of mainland Puerto Rico. The proposed facilities would be in the open oceanic waters of the Caribbean Sea and the coastal waters of Jobos Bay, both of which are considered marine waters based on salinity. Aguirre LLC would construct the Offshore GasPort approximately 3 miles (4.8 km) from the Aguirre Plant and about 0.6 mile (1 km) beyond Cayos de Barca, a cay that separates Jobos Bay from the open sea. The proposed subsea pipeline location extends approximately 4.0 miles (6.4 km) from the Offshore GasPort site, through the Boca del Infierno pass between of Cayos de Barca and Cayos Caribes, and across the basin of Jobos Bay to the Aguirre Plant (see figure 2.1-1).

Along the southern coast of Puerto Rico, bathymetry is characterized by an extensive insular shelf that provides for shallow nearshore waters and extends outwards more than 9 miles (14.5 km) in some areas. Beyond the shelf break, the water depth abruptly increases to over 1,500 feet (460 m) (NOAA, 2013a). Based on NOAA bathymetry mapping (NOAA, 2003), water depths at the proposed Offshore GasPort range from 60 to 65 feet (18 to 20 m) at mean low water[3]. The open oceanic waters beyond Jobos Bay are categorized as Marine, Subtidal, Unconsolidated Bottom by NWI mapping (FWS, 1983).

Jobos Bay is on the south-central coast of mainland Puerto Rico between the municipalities of Salinas and Guayama. According to Whitall et al. (2011), Jobos Bay is the second largest estuary in Puerto Rico, covering an estimated 6,177 acres (6,361 cuerdas), and is classified as a coastal plain estuary. The islands are characterized by extensive mangrove stands on the bay side and coral reef structures on the ocean side. Jobos Bay provides a natural harbor protected from offshore wind and waves by the barrier islands to the west and a peninsula (Punta Pozuelo) to the east. Portions of the bay have been classified as one of the 28 National Estuarine Research Reserves designated by NOAA. The Jobos Bay National Estuarine Research Reserve (JBNERR) encompasses approximately 3,300 acres (3,398 cuerdas) of coastal ecosystems, a portion of which would be crossed by the proposed subsea pipeline (see section 4.7.2).

Based on NOAA bathymetry mapping, water depths vary by location but are generally shallow and range between 10 and 20 feet (3 to 6 m) below mean low water (NOAA, 2003). The channels between the barrier islands are generally less than 4 feet (1.2 m) deep, except at Boca del Infierno pass (about 13 feet [4 m] deep), between Cayos de Barca and Cayo Morrillo (about 26 feet [8 m] deep), and between Cayo Morrillo and Cayos de Pájoros (over 26 feet [8 m] deep).

The main ship navigation channel in Jobos Bay is 150 feet (46 m) wide by 27 feet (8 m) deep and is maintained only as required, with the last maintenance occurring in the late 1990s or early 2000s (DNER, 2010). From the existing pier in the vicinity of the Aguirre Plant, the channel runs south, southwest, and west-southwest for about 4.5 miles (7.2 km), following the shoreline of the Mar Negro sector of the JBNERR. This sector is a mangrove-wetlands forest complex on the mainland southwest of the Aguirre Plant. The proposed subsea pipeline would be east of the navigation channel.

Jobos Bay features diverse marine habitats, including mangroves, mud flats, salt marshes, seagrasses, and coral reefs. Bottom substrates are represented by coral outcrops and depositional

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[3] Mean low water is defined as the average of all the low water heights observed over the National Tidal Datum Epoch. For stations with shorter series, simultaneous observational comparisons are made with a control tide station to derive the equivalent datum of the National Tidal Datum Epoch (NOAA, 2013c).

substrates that can vary from hard bottom materials to soft muds (Whitall, et al., 2011). The open waters of Jobos Bay are categorized as Estuarine, Subtidal, Unconsolidated Bottom by NWI mapping (FWS, 1983).

Winds

The northeastern Caribbean, including Puerto Rico, lies on the northerly fringe of the Trade Wind belt, which is associated with easterly winds (Field, et al., 2003). The strongest winds occur in the winter, with a slight decrease in strength during the summer. Wind speeds proximate to the Project area are moderate, ranging from 13 to 27 mph (21 to 44 km/hr) (see figure 4.3.1-1).

Short-term increases in wind speed can occur when tropical systems become imbedded in the east to west flow and pass across Puerto Rico. Based on the hindcast metocean data analysis performed for the Project (Forristall, 2013), extreme wind speeds of over 67 mph (108 km/hr) are common during the passages of these systems, with the associated direction dependent on the specific storm track. Between 1978 and 2008, 15 hurricanes crossed Puerto Rico, including Hurricane Georges in 1998 and Hurricane Jose in 1999, both of which impacted the Project area directly (Field et al., 2003). The bay itself is shielded from the full effects of hurricane winds by the Puerto Rican mainland and the encompassing barrier islands.

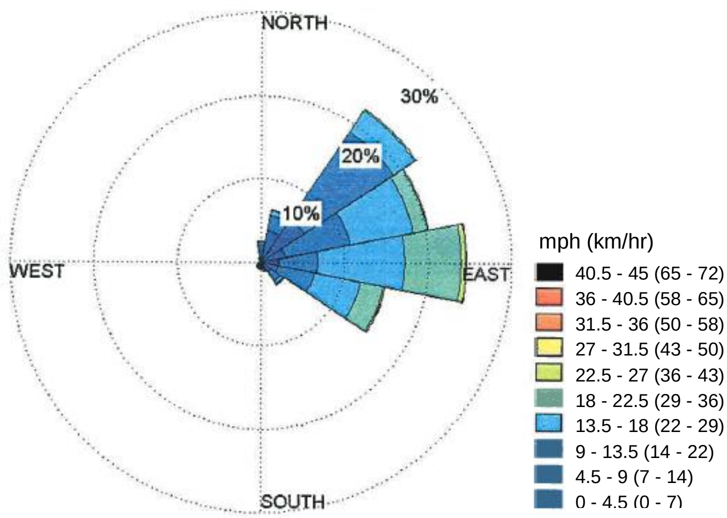


Figure 4.3.1-1 Yearly Average Wind Speed and Direction Proximate to the Project Area
Source: Forristall, 2013

Waves

Waves along the southern coast of Puerto Rico are generally produced by the prevailing easterly trade winds and influenced by topography and the behavior of the wind as it hits the barrier islands encompassing Jobos Bay. As offshore waves approach the Puerto Rican coastline from the east, they make contact with the seafloor, and then refract and turn towards shore, forming a westward longshore current (Field et al., 2003).

Waves produced by the trade winds typically range between 3 and 5 feet (1 to 1.5 m) in height in the open sea, with more placid conditions found within Jobos Bay (Field et al., 2003). Morelock and Williams (2008) describes Jobos Bay as a calm water area with low wave energy and current flow, characteristics that are attributable to the physical separation from the open ocean provided by the encompassing barrier islands; however, the channels between the islands provide for exchange of water with the open sea. Strong waves can develop in the narrower channels, where wave energy is concentrated by bed topography. In the Boca del Infierno pass, which would be crossed by the subsea pipeline, wave height is generally limited to less than 2 feet (0.6 m) because of the sill depth.

Short-term increases in wave height can occur from the passage of tropical systems (tropical storms and hurricanes) in the offshore areas encompassing the proposed terminal site. Table 4.3.1-1 summarizes the predicted extreme values of significant wave heights and associated return periods (an estimate of how often the given conditions would occur) in these areas during the passage of a tropical system.

TABLE 4.3.1-1

Extreme Values of Significant Wave Height in Tropical Storms

Return Period (years)	Wave Height in Feet (m)
5	14.8 (4.5)
10	18.4 (5.6)
50	26.1 (8.0)
100	29.3 (8.9)

Source: Forristall, 2013

Currents and Tides

Surface currents within the bay and the tide channel range between 0.1 and 0.6 mph (0.3 and 1.0 km/hr) and in a generally west to east direction, with an average value of approximately 0.2 mph (0.3 km/hr) observed throughout the year (Field et al., 2003). The current speeds are higher within the surge channels. Generalized current patterns within Jobos Bay are depicted on figure 4.3.1-2. The mean residence time for a water mass in Jobos Bay is about 5.5 days, with an average daily displacement of 39.9 million cubic yards (30.5 million m^3) (Field et al., 2003).

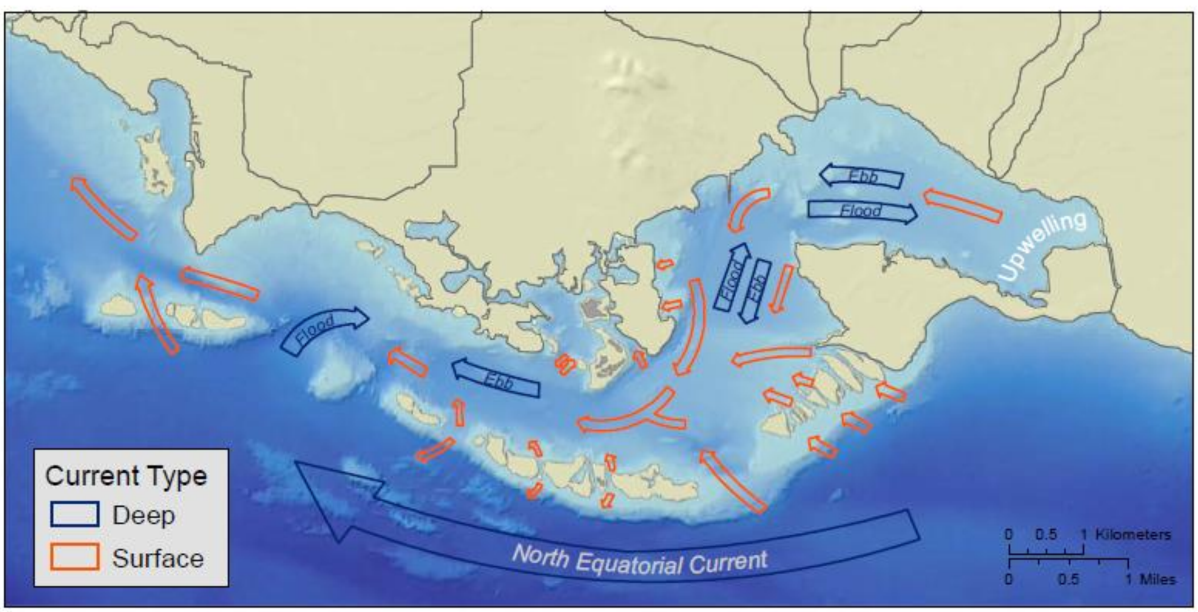


Figure 4.3.1-2 Generalized Current Patterns Within Jobos Bay
Source: Zitello et al., 2008

Current data were also analyzed from a buoy moored approximately 20 miles (32 km) west of the Offshore GasPort site. Buoy PR1 was placed by the Univeristy of Maine in 2010 and is part of the Caribbean Coastal Ocean Observing System (CariCOOS). Situated in a water depth of 56 ft (17 m) and equipped with an accoustic doppler current profiler, this buoy measures current speed and direction in 1-foot increments from 6 to 52 feet (2 m to 16 m), along with an array of other water and atmospheric parameters. The data show seasonal variability in current speed across the water column; however, current direction is relatively constant, flowing predominantly southwest year round. Figure 4.3.1-3 shows the average current speed throughout the water column during each season of 2011, 2012, and 2013 (CariCOOS, 2014) .

Physico-Chemical Water Properties

Temperature and Salinity

Caribbean Sea

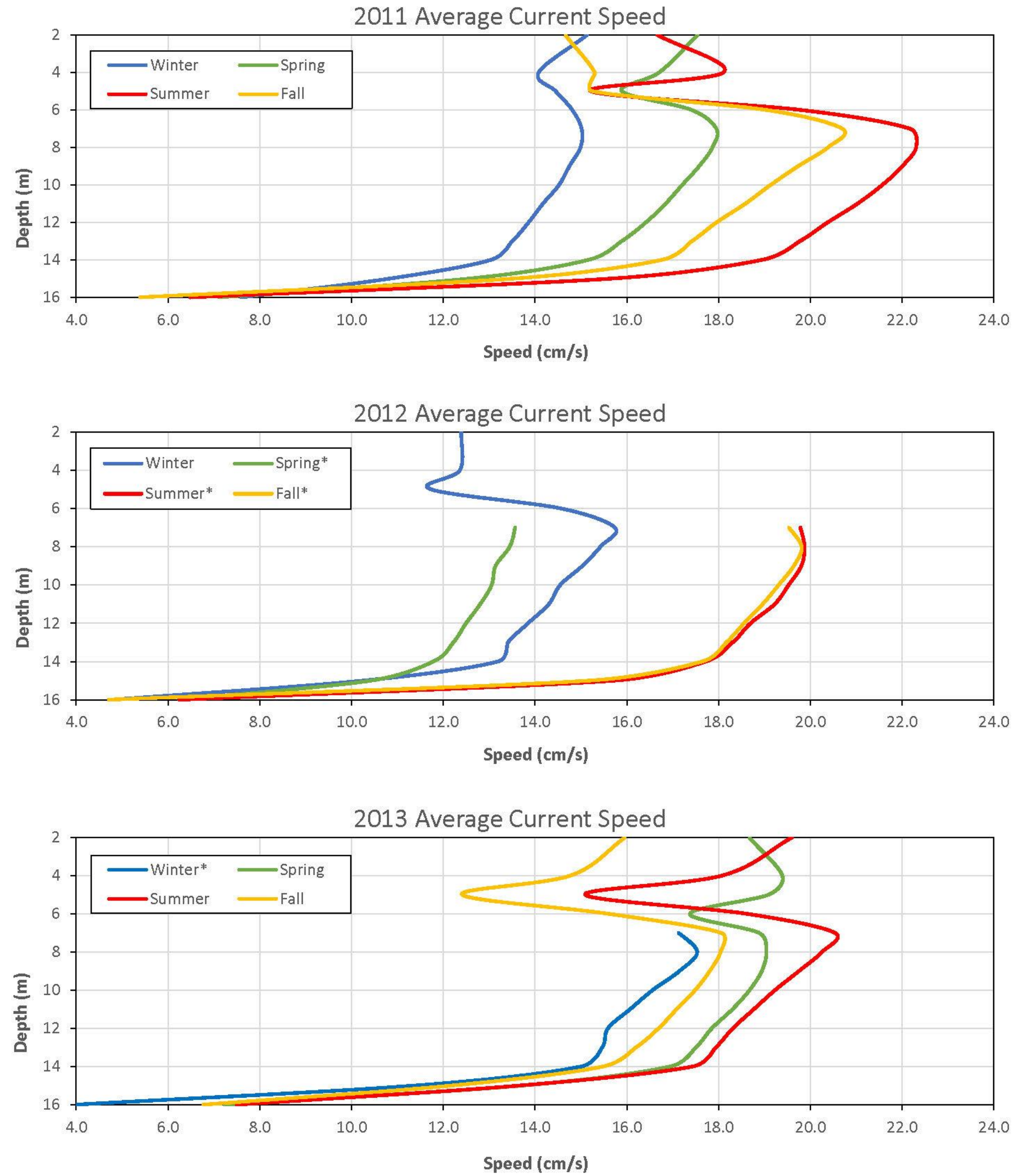
Sea surface temperatures collected as part of the hindcast metocean data analysis performed for the Project showed little variability, with the warmest values of approximately 85.3 °F (29.6 ºC) occurring in summer and the coolest values of approximately 79.3 °F (26.3 ºC) occurring in winter (Forristall, 2013). Typical salinity in the area ranges from 34.0 parts per thousand (ppt) in the spring to 36.3 ppt in the fall (Center for Energy and Environment Research, 1981).

The University of Puerto Rico, on behalf of Aguirre LLC, measured temperature and salinity at various depths along four ichthyoplankton survey transects, positioned between 0.5 and 2 miles (0.8 and 3.2 km) east of the proposed platform site (University of Puerto Rico, 2012). The results of this investigation showed no depth gradient for salinity or temperature.

Jobos Bay

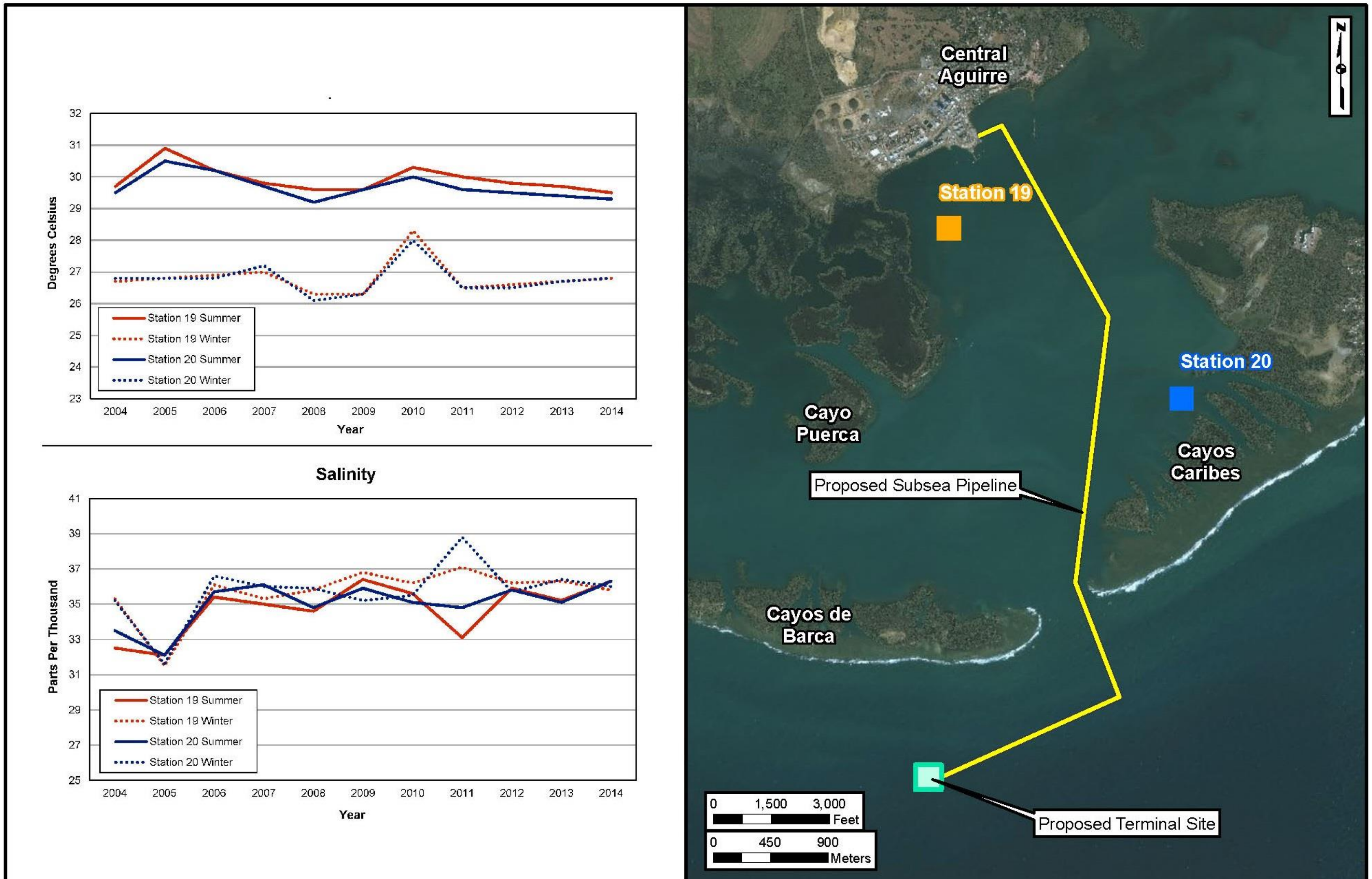
The National Estuarine Research Reserve System (NERRS) runs a System-Wide Monitoring Program that measures water quality parameters such as temperature, salinity, depth, turbidity, pH, dissolved oxygen, nutrient levels, and chlorophyll fluorescence at each of the reserves (NERRS, 2014). There are four active water quality monitoring stations within the JBNERR; of these, two stations are near the Project area and two are in the Mar Negro coastal mangroves (about 1.5 and 2.8 miles [2.4 and 4.5 km] west of PI 4). Station 20 is located on the landward side of the Cayos Caribes, about 0.5 mile (0.8 km) southeast of PI 4, and has been in operation since 2002. Station 19 is located about 0.5 mile (0.8 km) southwest of the Aguirre Plant where the subsea pipeline makes landfall, and it has been collecting data since 2002.

According to data from this program, Jobos Bay maintains relatively stable temperature and salinity levels. Average summer high temperatures reach 85.6 °F (29.8 °C) and winter lows average 80.2 °F (26.8 °C). Salinity has no discernable seasonal or annual fluctuations; the data collected at Stations 19 and 20 show an average of 35.3 ppt (NERRS, 2014). Figure 4.3.1-4 identifies the location of Station 19 and 20 and provides a summary of the temperature and salinity data collected since 2002.



* Data missing from 4 to 6 meters

Figure 4.3.1-3
CariCOOS Buoy PR1 Acoustic Doppler Current Profile
Aguirre Offshore Gasport Project



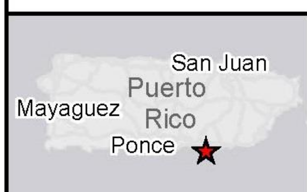


Figure 4.3.1-4
JBNERR Water Quality Monitoring Stations
Aguirre Offshore GasPort Project

Other Parameters

The University of Puerto Rico also collected surface water data for pH, conductivity, and dissolved oxygen during the ichthyoplankton field survey. Table 4.3.1-2 summarizes the result of the water quality data collected.

TABLE 4.3.1-2

Water Quality Data Collected in Vicinity of Proposed Offshore GasPort Site (May 2012) [a]

Water Quality Parameter	Minimum	Maximum	Mean
Temperature (ºF [ºC])	82.0 (27.8)	82.2 (27.9)	82.0 (27.8)
pH	8.0	8.1	8.1
Salinity (ppt)	35.4	35.4	35.4
Conductivity (µS/cm)	47,590	49,120	47,956
Dissolved Oxygen (mg/L)	5.3	8.7	7.5
Dissolved Oxygen (percent saturation)	78.1	120	108

Source: University of Puerto Rico, 2012

[a] Measurements taken at water depths of up to 3 feet (1 m).

Notes: ppt = parts per thousand; µS/cm = micro-siemens per centimeter; mg/L = milligrams per liter

Turbidity is a measure of water clarity and the amount of light blocked by material suspended in the water, whereas total suspended solids is a measure of material weight per water volume. Suspended materials include sediment (clay, silt, and sand particles), algae, plankton, microbes, and other substances, typically ranging in the size range from 0.004 millimeters (mm) (clay) to 1.0 mm (sand). Turbidity can increase water temperature because suspended particles absorb more heat than clear water; this in turn decreases dissolved oxygen, which can cause biological stress (EPA, 2012). Average turbidity levels measured during 2014 at NERRS Stations 19 and 20 were 5 and 3 nephelometric turbidity units, respectively. Water clarity/transparency, which provides a default measure of turbidity, can be measured with a Secchi disk[4]. Jobos Bay and its adjacent nearshore waters are relatively shallow and Secchi transparency ranges from 3 to 13 feet (1 to 4 m). These low readings are attributable to the presence of relatively high levels of suspended sediment and plankton (Morelock and Williams, 2008).

4.3.1.2 Water Uses and Quality

Current Uses

Major water uses in Jobos Bay and surrounding areas include fishing, recreational uses (e.g., tourism, swimming/beaches, boating, scuba diving), and scientific research (see section 4.7). The bay waters are also used for industrial purposes, including the supply of cooling water for local industry (e.g., the Aguirre Plant) and treated/process water discharges (EQB, 2010a).

Designated Uses and Regulatory Classification

The Puerto Rico Water Quality Standards Regulation (PRWQSR), as amended, establishes the designated uses to be maintained and protected for all waters in the archipelago of Puerto Rico, with the most recent version in March 2010 (EQB, 2010b). The designated uses include: 1) protection and propagation of fish, shellfish, and wildlife; 2) direct and indirect contact recreation; and 3) raw source of drinking water. The PRWQSR also identifies the water quality standards that have been adopted to protect each of the designated uses (EQB, 2012).

[4] A Secchi disk is a black and white disk, approximately 12 inches (30cm) in diameter, which is lowered by hand into the water to the depth at which it vanishes from sight.

The waters in the Project area are classified as Class SB and SC. Class SB waters include coastal and estuarine waters extending from the tidal zone (mean sea level) up to 0.3 mile (0.5 km) seaward that are not classified as Class SA (waters of high quality and/or exceptional ecological or recreational values) or Class SC. The Class SC designation applies to waters that lie beyond Class SB waters, between 0.31 and 10.4 miles (0.5 and 16.7 km) seaward (EQB, 2012). Based upon these geographic boundaries, the subsea pipeline would cross both Class SB and Class SC waters in Jobos Bay, whereas the Offshore GasPort and the section of the pipeline in the Caribbean Sea would be wholly in Class SC waters.

Class SB waters are designated for primary and secondary contact recreation and for propagation and preservation of desirable species, including threatened and endangered species. The Class SC waters in the Project area are designated for primary contact recreation between 0.3 to 3.0 miles (0.5 and 4.8 km) seaward, for secondary contact recreation between 3.0 and 10.4 miles (4.8 and 16.7 km) seaward, and for the propagation and preservation of desirable species, including threatened and endangered species, across the whole area.

Water Quality Standards and Evaluation

Based on the PRWQSR standards, no heat can be added to any waters of Puerto Rico that would cause the temperature of any site to exceed 90 ºF (32 ºC), except by natural causes (EQB, 2010b). With respect to dissolved oxygen, Class SB waters cannot contain less than 5 mg/L and Class SC waters shall not contain less than 4 mg/L, except when this value is depressed due to natural causes. The turbidity standard for Class SB and Class SC waters requires that turbidity not exceed 10 nephelometric turbidity units, except by natural causes.

For the purposes of biennial water quality evaluations under Sections 305(b) and 303(d) of the CWA, Jobos Bay and the adjacent offshore waters are in the South Region Coastal Shoreline sector of the Puerto Rico Coastal Segmentation Unit (PRSC34) (EQB, 2010a). The most recent approved EQB 305(b) and 303(d) integrated report (EQB, 2010a) lists the waters of PRSC34 as Category 5 (non-attainment) for primary contact recreation and aquatic life standards at select stations, and Category 1 (full attainment) for secondary contact uses (recreational swimming, fishing, and boating).

For a waterbody to be designated as Category 5, at least one water quality standard has not been attained (impaired or non-supporting of designated uses). Non-attainment within PRSC34 for primary contact is caused by elevated fecal coliforms and *Enterococcus* counts. Non-attainment for the aquatic life use is caused by pH imbalances, low dissolved oxygen levels, and elevated turbidity. Sources of pollution in PRSC34 include major industrial point sources, agricultural runoff, urban runoff, wastewater systems, and upstream impoundments (EQB, 2010a).

4.3.1.3 General Impacts and Mitigation

Offshore Berthing Platform

Construction of the offshore berthing platform would involve the placement and driving of deep-seated pilings into the seafloor to provide a foundation for the dock and mooring structures. Aguirre LLC would drive 13 pile structures into the seafloor, including 9 main piles with tubular steel jackets and 4 unjacketed tri/quad piles (see section 2.3.1). These activities would cause the displacement of sediments on the seafloor and the resuspension of sediments into the water column. The placement of the steel jackets on the seafloor and subsequent pile installation would cause most of the sediment disturbance. The insertion of the piles into the seafloor would directly displace a corresponding volume of substrate and the vibrations caused by a vibratory or impact hammer could dislodge and cause resuspension of surrounding material.

The amount of resuspended material generated by jacket and pile installation, and its distribution through time and space, would depend primarily on the duration and vibratory strength of the pile-driving, the depth below the seafloor to which the piles would be driven, and grain size. The placement of mooring anchors and chains to secure the berthing platform would also cause some sediment resuspension. Based on the sea depth (60 to 65 feet [18 to 20 m]) relative to the draught of the construction vessels (typically less than 25 feet [8 m]) that would be operating at the site of the offshore berthing platform, we would not expect the construction vessels to cause significant sediment disturbance through anchoring, propeller wash, or water uptake/discharge operations.

Turbidity levels in the areas adjacent to construction activities would likely exceed PRWQSR standards. However, these impacts would be temporary and localized, and the course sediments would quickly fall out of suspension and revert to previous turbidity levels after construction is complete. Further, given the unconfined extent of the oceanic environment in which the construction activities would occur, the topographic and structural uniformity of the seafloor in the area, and the lack of any evident sources of contamination, the temporary resuspension of sediment and associated elevated turbidity may cause short-term water quality impacts, but we believe these impacts would not be significant.

Subsea Pipeline

As discussed in section 2.3.3, Aguirre LLC proposes to lay its 4.0-mile-long (6.4 km) subsea pipeline directly on the seafloor, and subsequently bury a majority of the pipe using hand jets. Sediment disturbed during pipeline placement and burial would be resuspended in the water column and transported by currents. If a portion of the pipeline is constructed using the HDD technique (see section 4.5.2.4), sedimentation would also occur at the HDD entry and exit points: these effects would be temporary and would subside following construction. Other construction activities, such as augering and operation of the spud barges would introduce sediment into the water column.

The effects of the pipeline construction activities on turbidity levels would vary with the length and severity of disturbance, grain size composition, and resettling rates. Based on rapid settling rates, we conclude construction activities in the areas with coarse sediments (outer Jobos Bay to the Offshore GasPort) would have only minor impacts on water quality associated with short-term, localized turbidity increases. As discussed in section 4.2.3.2 above, construction along the remainder of the pipeline route result in more widespread turbidity due to the prolonged resettling rates of the finer sediments found in that portion of the bay. In both cases, the temporary, sequential nature of pipeline installation activities would limit the temporal and spatial extent of sediment resuspension and turbidity. As such, overall water quality impacts would be relatively short-term and minor.

Construction-Related Water Withdrawals and Discharges

Offshore Berthing Platform

Construction of the offshore berthing platform would involve the use of multiple support vessels, including material transport barges, tugs, crew/supply vessels, a dive support vessel, and a crane barge. Larger vessels may require the uptake of sea water for ballast and all vessels would require the uptake and discharge of sea water for engine cooling. These uptakes and discharges would be localized, temporary, and intermittent and we conclude they would not have any significant impacts on ambient water quality.

Subsea Pipeline

Under DOT regulations (49 CFR 192), Aguirre LLC is required to verify the integrity of the piping associated with the Project facilities before placing them into service by conducting hydrostatic testing. This testing involves filling the pipeline with water, pressurizing it, and then checking for pressure losses due to pipeline leakage. Aguirre LLC would pump seawater for testing into the pipeline using portable, high volume pumps on the offshore lay barge. The intake rate would be between 14,900 and 22,500 gallons per hour (56 to 85 m^3 per hour [m^3/hr]). The water intake would be about 6 feet below the surface and would be fitted with a 100-micron screen to prevent intake of organisms. Hydrostatic testing would require about 240,000 gallons of water (909 m^3) to fill the pipeline and complete one full hydrostatic test. Aguirre LLC does not anticipate the need for more than one full test, although some water replenishment may be required if isolated connections or flanges need depressurizing and retightening. No consumptive losses, temperature changes, or biocide treatment of the test water is anticipated.

Following the completion of the hydrostatic testing, the pipeline would be emptied, pigged, and purged with nitrogen or air to prepare for the receipt of natural gas. Aguirre LLC would filter all test water through a 100-micron filter system before discharging it at the shoreline approach of the pipeline in Jobos Bay. The discharge would be directed through a pipe secured about 6 feet (1.8 m) below the bay's water surface to minimize surface disturbance. To reduce discharge velocity and minimize sediment resuspension at the point of discharge, Aguirre LLC would attach a diffuser head to the discharge pipe during dewatering operations. Given the subsurface discharge and use of a diffuser, use of a 100-micron filter during withdrawal and discharge, and no change in water volume or temperature, we do not expect water quality impacts associated with test water uptake or discharge. In addition, Aguirre LLC would obtain all required permits and authorizations to conduct hydrostatic testing.

In addition to hydrostatic testing, construction of the subsea pipeline would involve the use of multiple marine support vessels including a lay barge, tug, pipe boat, dive vessel, crew boat, and various smaller vessels. During construction, certain vessels may require the uptake and discharge of sea water for engine cooling. These uptakes and discharges would be localized, temporary, and intermittent and are not expected to have any significant impacts on ambient water quality.

Operation-Related Water Withdrawals

Of the Project's four principal facility components (i.e., FSRU, LNG carriers, offshore berthing platform, and subsea pipeline), only the FSRU and LNG carriers would have operation-related water withdrawals. The offshore berthing platform would not be equipped with its own withdrawal systems; instead, it would be serviced via the FSRU systems. Water withdrawal profiles, impacts, and mitigation for the FSRU and LNG carriers are described below.

Floating Storage and Regasification Unit

Routine operations would require seawater use, whether the FSRU was in standby mode or vaporization mode. These operations would involve maintenance of the vessel's main and auxiliary cooling systems, regulation of ballast water, provision of a safety water curtain during LNG transfer and regasification, and maintenance of a desalination system to provide freshwater for hoteling and sanitary purposes. Non-routine uses for seawater include maintenance of the water deluge and fire main systems, which would run off dedicated pumps with an approximate flow capacity of 232,000 to 238,000 gallons per hour (880 to 900 m^3/hr).

The normal water use of the FSRU would total approximately 56 million gallons per day (mgd) (211,800 m^3 per day [m^3/day]) of seawater, including 53 mgd (200,600 m^3/day) to support machinery cooling through operation of the main condenser and auxiliary seawater cooling systems, 0.6 mgd (2,270 m^3/day) to generate the vessel's water safety curtain, and 2 mgd (7,200 m^3/day) for ballast water. All of the water used for these purposes would be discharged back into the surrounding ocean. Approximately 0.3 mgd (1,135 m^3/day) would be used in the FSRU's freshwater generation system, of which 0.03 mgd (115 m^3/day) would be consumed. Table 4.3.1-3 summarizes the anticipated standard intake (and discharge) volume requirements.

TABLE 4.3.1-3

Summary of Standard FSRU Water Use Intakes and Discharges [a]

Facilities	FSRU Seawater Intake (mgd [m^3/day])	FSRU Seawater Discharge (mgd [m^3/day])
Main Condenser Cooling System	47.0 (177,900)	47.0 (177,900)
Auxiliary Seawater Cooling System	6.0 (22,700)	6.0 (22,700)
Safety Water Curtain	0.6 (2,270)	0.6 (2,270)
Ballast Water	1.9 (7,200)	1.9 (7,200) [b]
Freshwater Generator	0.3 (1,135)	0.27 (1,020)
Total:	**55.8 (211,205)**	**55.77 (211,085)**

[a] Based on standard continuous operation of an Excelerate Energy FSRU in closed loop regasification.
[b] Discharge based upon loading rate and buoyancy compensation needs for the FSRU.

All water used to support FSRU operations would be drawn through four sea chests on the sides of the vessel: starboard high, starboard low, port high, and port low. Each sea chest would draw water through a series of grids. For the high sea chests, approximately 22.8 feet (7 m) below the ocean surface, there would be four grids on the starboard side and eight on the port side; for the low sea chests, approximately 37.4 feet (11.4 m) below the ocean surface, there would be six grids on the starboard side and eight on the port side.

Each sea chest grid would have metal gratings with 0.87-inch-diameter (2.2 cm) slots between the grating bars. The high sea chests would have an open area of 8.2 square feet (0.8 square meters [m^2]) per grid and a total open area of 98.4 square feet (9.1 m^2). The low sea chests would have an opening of 6.9 square feet (0.6 m^2) per grid and a total open area of 96.6 square feet (9.0 m^2). The total open area for all four sea chests would be 195 square feet (18.1 m^2). Seawater would be drawn horizontally through the high sea chests and vertically through the low sea chests. Under normal water use capacity, the calculated through-screen velocity of water entering the sea chests would be approximately 0.45 ft/sec (0.14 m/s), which is just below the upper velocity threshold of 0.5 ft/sec (0.15 m/s) recommended as best available technology to minimize impingement of aquatic organisms (EPA, 2001). Potential impacts of the FSRU water uptake on marine organisms are discussed in more detail in sections 4.5 and 4.6.

The FSRU would circulate water drawn through the sea chests through the five main vessel operating systems (Main Condenser Cooling, Auxiliary Seawater Cooling, Water Curtain, Freshwater Generator, and Hoteling and Sanitary Treatment) and discharge at various outfall locations along the FSRU deck and hull. Consumptive volume from the freshwater generator would be used for sanitary system supply, boiler make-up water, and potable supply. Water in excess of that needed for operations would be discharged as part of the freshwater generator effluent.

The FSRU's seawater uptake would represent a negligible volume of water relative to the surrounding ocean. For reference, the 56 mgd (211,800 m^3/day) total withdrawal volume represents the water contained in an approximately 195 cubic feet (5.5 m^3) section of the Caribbean Sea in the vicinity of the Offshore GasPort.

LNG Carriers

While unloading LNG at the Offshore GasPort, visiting LNG carriers would take in seawater as ballast to maintain stability. Each LNG carrier would take ballast water up through the vessel's sea chests over an estimated 25 to 72 hours. No ballast water would be intentionally discharged from LNG carriers while at the Offshore GasPort. Ballast water is typically only discharged during loading operations at an LNG export terminal or in mid-ocean ballast water exchanges during transit. Ballast water may be chlorinated to eliminate biofouling of machinery cooling systems, water intake pumps, and piping.

LNG carriers unloading LNG would also need cooling water for the engines that generate electrical power for the offloading pumps and other onboard systems. Ships' engines are powered up while at dock; therefore, LNG carriers would need cooling water during the entire time they are moored (estimated at 41 to 88 hours).

LNG carriers calling at the Offshore GasPort could range in size from 33 to 57 million gallons of LNG (125,000 to 217,000 m^3) and be powered either by diesel engine or steam-turbine engine. The majority of smaller class vessels are steam turbine driven (CH_2M Hill, 2008), which use more cooling water than diesel engines.

Aguirre LLC's quantitative estimates for LNG carrier water use were derived from three sources; the Jordan Cove final EIS (FERC, 2009), the Broadwater LNG final EIS (FERC, 2008), and information provided by Oregon LNG in its application to the FERC (CH_2M Hill, 2008). Estimated cooling water intake rates ranged from a low of 0.3 million gallons per hour (mgh) (1,250 m^3/hr) based on diesel engine vessels using supplemental power from onshore facilities to a high of 2.6 mgh (9,800 m^3/hr). Similarly, the three sources indicate significant variation in ballast water intake rates from 0.7 to 1.0 mgh (2,600 to 3,900 m^3/hr). Table 4.3.1-4 summarizes the potential ranges of cooling ballast water and intake rates, volumes, and durations for the LNG carriers. Aguirre LLC indicated that, based on the type and size of the LNG carriers in the current fleet, the higher estimates in each case are most likely to be representative of the Project.

TABLE 4.3.1-4

Estimates of LNG Carrier Water Use and Intake Rates at the Offshore GasPort

Range	Time to Offload (hours)	Total time at AOGP (hours)	Ballast Intake Rate (mgh [m^3/hr]) [a, b]	Ballast Volume (million gallons [m^3])	Cooling Intake Rate (mgh [m^3/hr])	Cooling Volume (million gallons [m^3])	Total Intake Volume (million gallons [m^3])
Low	25	41	0.7 (2,600)	17.2 (65,100)	0.3 (1,250)	13.5 (51,100)	30.7 (116,200)
High	72	88	1.0 (3,900)	74.2 (280,900)	2.6 (9,800)	227.8 (862,300)	302.0 (1,143,200)

[a] All ballast intake occurs during offloading.
[b] Low value from FERC, 2009; high value from FERC, 2008.

LNG carriers would require about 17.2 to 74.2 million gallons (65,100 to 280,900 m^3) of water for ballast while offloading at the Offshore GasPort. Total cooling water intake volume would range from about 13.5 to 227.8 million gallons (51,100 to 862,300 m^3) during LNG delivery. Therefore, the combined water intake for ballast and cooling water for each LNG delivery would range from about 31 to 302 million gallons (116,200 to 1,143,200 m^3).

Seawater uptake by visiting LNG carriers would represent a negligible volume of water relative to the surrounding sea. For reference, the maximum 302 million gallons (1,143,200 m^3) required for ballast and cooling water represents the water contained in an approximately 340 cubic feet (9.6 m^3) of the Caribbean Sea in the vicinity of the Offshore GasPort.

Operation-Related Water Discharges

Of the Project's four principal facility components (i.e., FSRU, LNG carriers, offshore berthing platform, and subsea pipeline), only the FSRU and LNG carriers would have operation-related water discharge systems. The offshore berthing platform would be serviced via the FSRU systems. The heated water from the FSRU's engine cooling systems would represent the main water discharge during operation. LNG carrier discharges would be of similar volume to the FSRU discharges but with a smaller temperature rise relative to ambient sea temperature.

Water discharges have the potential to impact ambient water quality and biotic communities where discharge parameters fail to meet recognized standards and thresholds, generally embodied in regulations and permit conditions. Temperature standards are of particular significance here, based on the magnitude of the predicted cooling water discharges from the FSRU and LNG carriers. Residual chlorine standards are also relevant because one of the discharges would be treated with sodium hypochlorite as a sanitary disinfectant. Elevated temperature and chlorine levels can have sub-lethal or lethal effects on marine biota, depending on the magnitude and duration of the increase. Similar effects can occur if other contaminants, such as oil, grease, and metal particulates, are present in discharge water.

Floating Storage and Regasification Unit

During routine operations, the FSRU would operate with six permitted outfalls (001 through 006) and separate ballast outlets. Discharge sources for each of the outfalls (which correspond to functional use and/or derivation of discharged water, not necessarily actual discharge locations) are summarized in the following sections.

Outfall 001 – Main Condenser Cooling Water Discharge

The FSRU would utilize the steam from on-board boilers to drive the main turbine and turbo generators that provide power for the vessel's propulsion system, electric generation system, and auxiliaries. During vessel passage, which would occur when the FSRU first sails to the Offshore Gasport and at intermittent times thereafter, seawater would be used to cool and condense exhaust steam in the vessel's main condenser, allowing heat dissipation. The same main condenser cooling system would operate during LNG transfer and regasification operations at the Offshore Gasport.

The FSRU's main condenser cooling system would require the intake and discharge of approximately 47 mgd (177,900 m^3/day) of seawater during periods of normal capacity water use associated with LNG transfer and regasification. Intake water would circulate through the cooling system prior to discharge through a 55-inch-diameter (1.4 m) pipe (Outfall 001) on the side of vessel, 17.4 to 24.3 feet (5.3 to 7.4 m) below the ocean surface.

The JETLAG/VISIJET (JETLAG) Model (Lee and Cheung, 1990: Lee and Chu, 2003; Choi and Lee, 2007) was used to predict and analyze the spatiotemporal characteristics of the thermal plume associated with the discharge from the Main Condenser Cooling System. Parameters that were factored into the modeling include water discharge rate (momentum) and volume, thermal dissipation characteristics, and outlet port dimensions.

An elevation in water temperature of 21.6 ºF (12.0 ºC) above ambient (85.3 ºF [29.6 ºC]) was used to model the proposed mixing zone[5] for Outfall 001. This temperature increase was estimated based on operating records for the Northeast Gateway Energy Bridge Project (the best available data for estimating temperature differential), which showed a lower (4.7 °F [2.6 °C]) change in ambient due to lower existing water temperatures (EPA, 2007). Aguirre LLC assumed that this temperature differential (delta–t) would be representative of that associated with cooling water discharge from the Project's FSRU. Applying a delta-t of 21.6º F (12.0 ºC), the maximum discharge temperature at Outfall 001 was estimated at 106.9 ºF (41.6 ºC). This maximum temperature was compared against a thermal compliance value of 90º F (32 ºC), which is the EQB's ambient threshold that cannot be exceeded by the addition of higher temperature water other than through natural causes or by establishment of a permitted mixing zone (EQB, 2010b). Using these data, the mixing zone was calculated to be a 135-foot (41 m) radius[6] from the outlet port based on EPA guidelines (EPA, 1991). Aguirre LLC submitted its application for an interim mixing zone to the EPA and EQB on May 16, 2014 (Tetra Tech, 2014f). Additionally, Aguirre LLC would monitor the discharge temperature during operations to ensure it complies with the NPDES permit for the Project and EQB's ambient temperature threshold.

The result of the JETLAG modeling for the "no current" and "minimal current" scenarios (0.3 ft/sec [0.1 m/s]) are summarized in table 4.3.1-5. Under the "no current" scenarios, attainment of the 90 ºF (32 ºC) temperature criterion was calculated at a maximum horizontal distance of 33.7 feet (10.3 m)[7] from the discharge port and at a maximum depth of 22.8 feet (6.9 m). When modeled with a minimal current, the temperature criterion was attained at a maximum horizontal distance of 25.4 feet (7.8 m) and a maximum vertical depth of 23.4 feet (7.1 m). Therefore, the net increase in thermal loading is expected to have only a localized effect on water quality, well within the boundary of the 135 feet (41 m) mixing zone. The plume is predicted to dissipate beneath the FSRU's hull and not reach the seafloor.

TABLE 4.3.1-5

Temperature Criterion Attainment Profile for FSRU Outfall 001 Thermal Plume Based on the JETLAG Model

Case	Discharge Depth (feet [m])	Ambient Velocity (ft/sec [m/s])	Temperature Criterion (ºF [ºC])	Horizontal Distance for Criterion Attainment (feet [m])	Water Depth for Criterion Attainment (feet [m])	Plume Contact with Seafloor
1	17.4 (5.3)	0	90 (32)	33.7 (10.3)	15.9 (4.8)	No
2	20.8 (6.4)	0	90 (32)	33.7 (10.3)	19.3 (5.9)	No
3	24.3 (7.4)	0	90 (32)	33.7 (10.3)	22.8 (6.9)	No
4	17.4 (5.3)	0.3 (0.1)	90 (32)	25.4 (7.8)	16.6 (5.0)	No
5	20.8 (6.4)	0.3 (0.1)	90 (32)	25.4 (7.8)	20.0 (6.1)	No
6	24.3 (7.4)	0.3 (0.1)	90 (32)	25.4 (7.8)	23.4 (7.1)	No

Under the NPDES, a permitted mixing zone would be inherently protective of area-wide water quality and thermal discharges from Outfall 001 (and Outfall 002) as they would have to comply with

5 A mixing zone is an allocated impact zone where water quality criteria can be exceeded as long as acutely toxic conditions are prevented (EPA, 1991).

6 Calculated based on 50 times the discharge length scale (2.7 feet [0.82 m]), which is the square root of the cross-sectional area of the discharge outlet (EPA, 1991).

7 All linear measurements for thermal plumes in this section are based on distance from the outlet port.

applicable regulatory requirements. Operation of the FSRU would be authorized by the EPA (the NPDES authority in Puerto Rico) only if the modeled mixing zone meets these requirements.

To prevent macrofouling of the FSRU's raw water intake systems, the FSRU would utilize its on-board copper-aluminum anode marine growth prevention system (MGPS). The system comprises a paired copper anode and an aluminum anode mounted in-line with the seawater intake system, connected to a control box that emits a direct electrical current to the anodes. This system allows a controlled release of copper and aluminum ions that coat the FSRU's seawater piping and prevents settlement of fouling organisms, inhibits corrosion, and results in increased operating efficiency. The MGPS would release, on average, 2 parts per billion (ppb) of copper ions at the beginning of the system, which is below the EQB Class SB/SC water quality standard of 3.73 ppb for copper discharge. Copper levels are expected to be lower than 2 ppb at the discharge location due to the copper ions coating the linings of the FSRU piping.

Outfall 002 – Auxiliary Cooling Water Discharge

Aguirre LLC used the JETLAG model to determine the thermal discharge plume associated with the auxiliary cooling water discharge from Outfall 002. Based on a similar FSRU currently in operation, a delta-t of 11.0 ºF (6.5 °C) above ambient temperature was assumed. As such, at an ambient temperature of 85.3 ºF (29.6 °C), the calculated maximum discharge temperature at Outfall 002 is 96.3 ºF (35.7 °C). The mixing zone was modeled to be a 47.5-foot (14.5 m) radius[8] from the outfall based on EPA guidelines (EPA, 1991). Aguirre LLC submitted its application for an interim mixing zone to the EPA and EQB on May 16, 2014 (Tetra Tech, 2014f).

The result of the JETLAG modeling for the "no current" and "minimal current" scenarios (0.3 ft/sec [0.1 m/s]) are summarized in table 4.3.1-6. Under the "no current" scenarios, attainment of the 90 ºF (32 ºC) temperature criterion was calculated at a maximum horizontal distance of 5.0 feet (1.5 m) and a maximum depth of 27.3 feet (8.4 m). With a minimal current of 0.3 ft/sec (0.1 m/s), attainment of the 90 ºF (32 °C) criterion was predicted within a maximum horizontal distance of 4.1 feet (1.3 m) and a maximum depth of 27.3 feet (8.4 m). Therefore, the net increase in thermal loading is expected to have only a localized effect on water quality, well within the boundary of the 47.5 foot (14.5 m) mixing zone. The plume is predicted to dissipate beneath the FSRU's hull and not reach the seafloor. Plume parameters developed under the "no current" and "minimal current" scenarios are summarized in table 4.3.1-6.

TABLE 4.3.1-6

Temperature Criterion Attainment Profile for FSRU Outfall 002 Thermal Plume Based on the JETLAG Model

Case	Discharge Depth (feet [m])	Ambient Velocity (ft/sec [m/s])	Temperature Criterion (ºF [°C])	Horizontal Distance for Criterion Attainment (feet [m])	Water Depth for Criterion Attainment (feet [m])	Plume Contact with Seafloor
1	20.4 (6.3)	0	90 (32)	5.0 (1.5)	20.4 (6.3)	No
2	23.9 (7.4)	0	90 (32)	5.0 (1.5)	23.9 (7.4)	No
3	27.3 (8.4)	0	90 (32)	5.0 (1.5)	27.3 (8.4)	No
4	20.4 (6.3)	0.3 (0.1)	90 (32)	4.1 (1.3)	20.4 (6.3)	No
5	23.9 (7.4)	0.3 (0.1)	90 (32)	4.1 (1.3)	23.9 (7.4)	No
6	27.3 (8.4)	0.3 (0.1)	90 (32)	4.1 (1.3)	27.3 (8.4)	No

[8] Calculated based on 50 times the discharge length scale (0.95 feet [0.29 m]), which is the square root of the cross-sectional area of the discharge outlet (EPA, 1991).

Outfall 003 A (Port) and B (Starboard) – Water Curtain

For safety purposes it is common practice for most LNG vessels to maintain a constant flow of water, referred to as a "water curtain," over the deck and hull of the vessel during LNG transfer or regasification. In the event of a LNG leak during these operations, the presence of the water curtain helps protect the metal hull from any potential cracking or stress. The FSRU would use seawater withdrawn through the high and low starboard and port sea chests, pumped onto the deck of the FSRU at a flow rate of approximately 0.6 mgd (2,270 m^3/day), and then discharged over the port and starboard sides of the vessel as runoff. As discussed above, water within the FSRU's internal piping system would be subject to treatment with copper-aluminum ions for biofouling control. We anticipate that these levels would diminish shortly after discharge and would not significantly affect water quality. We do not anticipate these discharges would result in any change in ambient temperature. All operational discharges would be subject to the requirements of the NPDES permit for the Project.

Outfall 004 – Freshwater Generator

The seawater supply for the freshwater generator would enter the FSRU through the high and low starboard and port sea chests. Approximately 0.3 mgd (1,135 m^3/day) of seawater would be withdrawn and piped to the freshwater generator, which would produce approximately 0.03 mgd (115 m^3/day) of freshwater. The FSRU would discharge the remaining 0.27 mgd (1,020 m^3/day) as brine water, which would exhibit slightly higher salinity content than the surrounding surface waters due to the concentrating effects of freshwater removal. Given the very low discharge volume relative to the oceanic receiving waters, the high brine concentration is not expected to result in noticeable water quality impacts.

Consumptive uses of the generated freshwater would include on-board potable supplies for drinking water and sanitary purposes, feed water for the main and auxiliary boilers, and make-up water. Any surplus freshwater would be stored on the vessel or discharged. All operational discharges would be subject to the requirements of the NPDES permit for the Project.

Outfall 005 – Ballast Water Systems

The FSRU would discharge ballast water in response to ongoing FSRU operations and vessel stability needs during the LNG loading and regasification processes. Ballast discharge volumes could reach 1.9 mgd (7,200 m^3/day) but would vary according to operational status and sea conditions. The on-board MGPS would be utilized to minimize the potential for macrofouling of the ballast system. Given that the ballast water for the FSRU would be withdrawn and discharged at the same Offshore Gasport location, there would be no possibility of invasive species being introduced through the release of ballast water originating from another location.

The FSRU would undergo dry-dock maintenance about every 5 years. During scheduled dry-dock periods, PREPA may require Aguirre LLC to use a similar FSRU to meet contractual send-out rates. The commissioning of the new and/or returning FSRU would likely require the discharge of ballast water from an offsite location. Due to the infrequency of these discharges and the fact that Aguirre LLC must comply with USCG's ballast water discharge requirements, we do not anticipate any significant impacts on water quality. All operational discharges would be subject to the requirements of the NPDES permit for the Project.

Outfall 006 Stormwater

Under normal operation conditions, dust and dirt are expected to accumulate on the decks and other exposed services of the FSRU. In addition, minor leaks of grease and other lubricants from on-board equipment could occur. When raining, these materials could become entrained in sheet-flow runoff from the decks, resulting in intermittent releases to the surrounding waters of the Caribbean Sea. To minimize impacts associated with stormwater discharges, Aguirre LLC would implement measures outlined its Stormwater Pollution Prevention Plan, which will be required as part of the NPDES permit, including the deployment of equipment drip vats and oil absorbent material around collection drains. We conclude that implementation of these measures would minimize the likelihood of stormwater impacts on the Caribbean Sea. All operational discharges would be subject to the requirements of the NPDES permit for the Project.

Hoteling and Sanitary Treatment System

Operation of the FSRU would generate galley, hotel services, and sanitary wastes. Water contributing to these wastes would be freshwater generated by the FSRU's on-board desalination system. Assuming 10 percent of the freshwater is used for sanitary system support, the FSRU would generate approximately 0.03 mgd (115 m^3/day) of black and gray wastewater from the restroom, hoteling, and galley services.

The FSRU would treat and manage wastewater on a daily basis in compliance with regulations set forth by the 1978 Protocol of the 1973/78 International Convention for the Prevention of Pollution from Ships (MARPOL, Annex IV). Under MARPOL, the FSRU would be required to have an approved on-board system to treat and disinfect sewage before offshore discharge or would need to store and periodically off-load sewage to a service vessel for transportation to a land-based treatment facility. Aguirre LLC has indicated that all black and gray wastewater would be treated by an on-board septic system then pumped to a service vessel and taken onshore for eventual disposal. This would preclude any water quality impacts associated with offshore discharge.

Bilgewater and Blowdown Water Management

The bilge is the lowest compartment of a ship's hull, below the waterline, where the two sides meet at the keel. Deck water from precipitation, heavy waves, and other sources that does not drain directly over the sides of the ship would drain down through the ship's interior into the bilge. The collected water must be pumped out periodically to maintain the ship's full stability and operational capacity. Bilge water contains materials that are washed off the drained surfaces. These materials, some of which may be derived from leaks and spills, can include oil, grease, detergents, solvents, and particulate matter (e.g., metallic particles [including rust] and dirt).

Bottom blowdown refers to the periodic removal of accumulated particulates, sludge, and other impurities from the bottom of a ship's boilers to facilitate safe operation and efficiency. These impurities, which include rust and other metallic particles, pH adjustment compounds, and anti-scaling agents, can become concentrated during continuing evaporation of steam. Without blowdown, this concentration can compromise the boiler's steam generation capacity and structural integrity.

USCG regulations (33 CFR 151.10) require ships to comply with specific conditions for marine bilge discharges when operating within 12 nautical miles (22 km) of the nearest land. These conditions relate to the oil content and origin of the bilge water and the use of monitoring, alarm, and oil-water separation equipment. Oily water that fails to meet specified treatment standards must be containerized and stored for off-vessel removal and treatment at an onshore certified treatment facility. In consideration of these conditions, Aguirre LLC has indicated that bilge water collected from the FSRU bilge sump pumps, together with comingled bottom blowdown water from the main and auxiliary boilers would be pumped off the FSRU for onshore disposal at a Puerto Rico government approved facility. As part of this process, residual oil and grease would be concentrated and containerized. The absence of any offshore discharge would preclude ambient water quality impacts.

<u>LNG Carriers</u>

The condenser cooling water system would be the dominant discharge associated with the LNG carriers while moored at the Offshore GasPort. Aguirre LLC used the same JETLAG modeling system for the thermal plume characteristics of the LNG discharge as was used for the FSRU. Intake and discharge parameters were identical to those selected for the FSRU, except for a slightly higher maximum volume intake rate and a maximum delta-t of 5.4 ºF (2.8 °C), which is based on off-loading characteristics from the Jordan Cove LNG Project (FERC, 2009).

The results of the JETLAG modeling for the LNG carrier discharges under the "no current" and "minimal current" scenarios are summarized in table 4.3.1-7. The modeling showed a confined plume with EQB's temperature criterion (90 ºF [32 °C]) attained at 2.7 feet (0.8 m) in the horizontal plain and up to 26.7 feet (8.1 m) in the vertical plain; under the minimal current scenario (0.3 ft/sec [0.1 m/s]), the temperature criterion was attained at 1.3 feet (0.4 m) in the horizontal plain and at up to 25.4 feet (7.7 m) in the vertical plain. Therefore, the temperature criterion is met close to the discharge outlet under both current scenarios. However, the elevated flow rate is projected to impact the seafloor across all discharge depths and under both current scenarios, with consequent implications for sediment resuspension.

TABLE 4.3.1-7

Temperature Criterion Attainment Profile for LNG Carrier Thermal Plume Based on the JETLAG Model

Case	Discharge Depth (feet [m])	Ambient Velocity (ft/sec [m/s])	Temperature Criterion (ºF [°C])	Horizontal Distance for Criterion Attainment (feet [m])	Water Depth for Criterion Attainment [a] (feet [m])	Plume Contact with Seafloor
1	17.2 (5.2)	0	90 (32)	2.7 (0.8)	19.8 (6.0)	Plume periphery
2	20.6 (6.3)	0	90 (32)	2.7 (0.8)	23.4 (7.1)	Plume periphery
3	24.0 (7.3)	0	90 (32)	2.7 (0.8)	26.7 (8.1)	Plume periphery
4	17.2 (5.2)	0.3 (0.1)	90 (32)	1.3 (0.4)	18.5 (5.6)	Plume periphery
5	20.6 (6.3)	0.3 (0.1)	90 (32)	1.3 (0.4)	22.1 (6.7)	Plume periphery
6	24.0 (7.3)	0.3 (0.1)	90 (32)	1.3 (0.4)	25.4 (7.7)	Plume periphery

[a] Depth is projected attainment of temperature criterion, plume momentum would impact bottom.

Cooling water discharges from LNG carriers would have to comply with applicable water quality criteria. Anti-fouling agents similar to those discussed for the FSRU above would be used by the visiting LNG carriers. We anticipate that these levels would diminish shortly after discharge and would not significantly affect water quality. Given compliance with EQB's temperature criterion of 90 ºF (32 °C) is reached close to the point of discharge, we do not anticipate that elevated temperature levels would constitute a significant water quality impact. Whereas thermal plume modeling suggests that sediment resuspension could be a recurring phenomenon, with each visiting carrier (approximately one carrier every 8 days) discharging cooling water for the duration of its stay (up to approximately 88 hours), the effects would be localized and relatively minor.

As discussed above, the LNG carriers would take on ballast water to maintain stability and operational readiness as their cargo is off-loaded. However, ballast water discharges are not anticipated during the off-loading process. Similarly, LNG carriers would not conduct routine blowdowns while at berth.

4.3.2 Onshore Surface Water Resources

4.3.2.1 Regional Characteristics

The Jobos Bay watershed, which is defined as the entire land area draining directly to Jobos Bay, covers 53 mi^2 (137 km^2) and is bordered by two perennial stream networks: Rio Nigua to the west and Rio Guamani to the east. The watershed's northern boundary begins in the foothills of the Central Interior Mountain Range and the southern boundary extends for about 28 miles (45 km) along the mainland coastline of the bay (Zitello et al., 2008).

Freshwater surface discharges to Jobos Bay from the adjoining watershed are limited to one major perennial river (Rio Seco, 2.3 miles [3.7 km] east of the Aguirre Plant), several small intermittent streams, and diffuse overland runoff. Due to the dry climate, the streams exhibit intermittent flow throughout the year without any seasonal emphasis. Year-round flow is also limited where the streams meet highly porous fan delta deposits and water infiltrates downwards, contributing significantly to groundwater recharge in the underlying aquifer (Quiñones-Aponte et al., 1997).

4.3.2.2 Water Quality

Zitello et al. (2008) indicates that in addition to run-off from high intensity developed areas and agricultural fields, additional sources of waterborne constituent inputs from the Central Aguirre subwatershed could include the Central Aguirre Golf Club, located 0.3 mile (0.5 km) from the Jobos Bay shoreline, along with a municipal landfill and dredge spoils from the Aguirre Navigation Channel, located 0.9 mile (1.5 km) from the shoreline.

4.3.2.3 General Impacts and Mitigation

None of the rivers or streams flowing into Jobos Bay are in the Project's construction footprint or would otherwise be directly impacted by construction or operation of the proposed facilities. Construction activities at the pipeline landfall, which would be within the fenceline of the Aguirre Plant, would likely involve the disturbance of soils in the vicinity of the shoreline. Soil disturbance and stormwater runoff have the potential to result in offshore sedimentation. Aguirre LLC would implement mitigation measures outlined in the FERC Plan and Procedures and the NPDES construction stormwater discharge permit and Stormwater Pollution Prevention Plan developed for the Project to avoid or minimize water quality impacts on shore and in the bay. These measures include maintaining erosion and sedimentation controls (e.g., silt fence) throughout construction, establishing refueling restrictions and spill control measures, and restoring disturbed areas when construction is complete.

4.3.3 Groundwater Resources

4.3.3.1 Regional Characteristics

Puerto Rico is underlain by an aquifer complex composed of limestone, alluvium, and volcanic rocks. The South Coastal Plain aquifer, which underlies the Jobos Bay watershed, extends east to west from Patillas to Ponce, and north to south from the bedrock hills near the watershed's northern boundary to the southern coastline of the bay. According to Quiñones-Aponte et al. (1997), the aquifer consists of a principal groundwater flow zone of fan delta and alluvial deposits, sandwiched between a deep zone of weathered bedrock and an upper zone of sand and gravel. Towards the coast, an increasing amount of fine-grained material in the upper zone impedes groundwater flow from the north and results in two discrete groundwater units: a shallow unit approximately 10 to 76 feet (3 to 23 m) thick and a deep unit below. The shallow unit is believed to supply the mangrove complex at the watershed's coastal margins, whereas the deep unit may provide freshwater to the offshore mangrove islands on the southern perimeter of Jobos Bay (Whitall et al., 2011).

The South Coastal Plain aquifer provides about one-half of the public water and agricultural irrigation supply of the south coast; the remainder is drawn from surface water sources. The main sources of groundwater recharge in this region are infiltration from freshwater stream flow and precipitation. Historically, regional groundwater moved from recharge areas southward to the coast with some recharge water moved laterally to major streams, mostly in downstream reaches. Discharge of groundwater was to streams and the open waters of Jobos Bay, and as direct evapotranspiration from the aquifer where the water table was shallow. However, a long history of drainage ditch and irrigation canal construction, coupled with well-water withdrawals for agricultural and industrial use, has greatly altered natural groundwater flow. Recharge has been augmented by surface water seepage from several irrigation canals that cross the region's alluvial areas and from the practice of furrow irrigation (USGS, 1999; Kuniansky, E.L., and Rodríguez, J.M., 2010).

4.3.3.2 Water Quality and Public Use

Groundwater resources intended for use as drinking water supply sources, agricultural uses including irrigation, and flow into coastal, surface, and estuarine waters and wetlands as defined in the regulation are protected under the PRWQSR (EQB, 2010b). The PRWQSR states that groundwater pH, color, turbidity, total dissolved solids, taste or odor substances, and dissolved gases (composition, combination, and concentration) shall not be altered except by natural causes; fecal coliform colonies shall not be present under specified sampling protocols; and surfactants (as methylene blue active substances) shall not be present.

The mainland surrounding Jobos Bay encompasses two public supply water aggregation service areas (USGS, 2008). These supply areas, designated as Areas 38 and 41, approximately bisect the drainage area and comprise the municipalities of Salinas to the west (Area 38) and Guayama to the east (Area 41). Public water supply is sourced from surface water and groundwater in Area 41 and groundwater only in Area 38.

Those water supply wells closest to the Project area were identified by Aguirre LLC through consultation with EPA Region 2 and EQB staff. No wells are within 3 miles (4.8 km) of the proposed Offshore GasPort. The closest well to the Project footprint is approximately 1.2 miles (1.9 km) north of the proposed pipeline landfall at the Aguirre Plant. The locations of the water supply wells are summarized in table 4.3.3-1.

TABLE 4.3.3-1

Water Supply Wells in the Vicinity of the Aguirre Offshore GasPort Project

Public Supply Reference	Name of Well Or Well Cluster	No. of Well Locations	Distance and Direction from Project (miles [km])	Municipality or Private Well
PR0004765	Cimarrona	1	3.3 (5.3), east	Guayama
PR0004775	Puente Jobos	2	4.0 and 5.0 (6.4 and 8.1), east	Puente Jobos
PR0004845	Guayama Urbano	2	3.1 and 4.1 (5.0 and 6.6),east	-
PR0004915	Coqui	3	1.4, 1.5 and 1.8 (2.3, 2.4 and 2.9), west	Salinas
PR0563015	Corporacion Azucarera Aguirre	1	1.2 (1.9), west	Private
PR0563065	AEE Aguirre Termoelec.	1	2.5 (4.0), west	Private

Sources: Espanol, 2012; Gould, 2012

4.3.3.3 General Impacts and Mitigation

The proposed Project facilities are at least 1 mile (1.6 km) from the closest known water well, and no direct intrusion into groundwater bearing strata, either through offshore pile placement or pipe laying is anticipated. Onshore facilities are restricted to the short section of overland pipeline between the Aguirre Plant and the Jobos Bay shoreline, which would be installed aboveground, precluding the need for trenching and physical connection with any shallow groundwater table that might exist. The Project would not affect municipal or private water supplies. However, spills or leaks of hazardous materials (e.g., fuel, lubricants) from construction or operation equipment could result in adverse impacts on groundwater. Construction contractors and port operations personnel would be required to comply with all laws and regulations related to handling of fuels and lubricants, including 40 CFR 110, and vessel-to-vessel transfers, including 33 CFR 155. Aguirre LLC has committed to preparing a site-specific Spill Prevention and Control Plan to minimize the potential for inadvertent release and to establish protocol for the containment, remediation, and reporting of accidental releases. Because Aguirre LLC has not yet provided its spill plan, **we recommend that:**

- **<u>Prior to construction,</u> Aguirre LLC should file a site-specific Spill Prevention and Control Plan for the construction and operation phases of the onshore and offshore portions of the Project with the Secretary for review and written approval by the Director of Office of Energy Projects (OEP).**

4.4 VEGETATION RESOURCES

4.4.1 Terrestrial Vegetation Resources

The proposed temporary staging and construction support area, where the subsea pipeline would reach landfall, is located entirely within the existing Aguirre Plant, which consists of previously disturbed industrial land with little or no vegetation coverage.

4.4.2 Marine Vegetation Resources

4.4.2.1 Mangroves

Mangroves are estuarine, intertidal, emergent scrub-shrub wetlands that are usually found along shorelines in the intertidal zone between open water and upland habitat (NMFS, 2011c). Mangroves serve as sediment traps, causing the accumulation of sediments, production of organic matter, and prevention of erosion. They are a vital component in the estuarine food chain, providing habitat for a large variety or organisms, which serve as a base to the food chain. Mangroves provide essential ecosystem services for Jobos Bay, including habitat for a variety of marine organisms (Whitall, et al., 2011).

Mangrove cays, including Cayos de Barca and Cayos Caribes, are on the southern and western edges of Jobos Bay and cover approximately 25 percent of the entire bay. Four species of mangroves are found within Jobos Bay: red mangrove, black mangrove, white mangrove, and buttonwood mangrove. The majority of the shoreline in the bay is dominated by red mangrove, which grows in silty soils in tidally flooded areas and is the most water-tolerant of the four mangrove species.

The closest mangrove island to the proposed Project facilities is approximately 600 feet (183 m) east of MP 2.0 of the subsea pipeline.

4.4.2.2 Seagrass and Macroalgae

Submerged aquatic vegetation (SAV) is the most common benthic cover type in Jobos Bay. Seagrass is the dominant cover in approximately 30 percent (3,000 acres [3,089 cuerdas]) of the bay; macroalgae (seaweed) is the dominant cover in an additional 20 percent (2,000 acres [2,049 cuerdas]) (Whitall et al., 2011). Seagrasses provide food and shelter to commercial and recreational fishery species as well as manatees, sea turtles, invertebrates, and birds. Seagrasses also reduce wave and current action and improve water clarity and quality. Seagrass beds are more prevalent near the shore, where they cover some 70 percent of Jobos Bay's shallows (Field et al., 2003). The seagrass flora in Jobos Bay is relatively diverse and includes turtle grass (*Thalassia testudinum*), manatee grass (*Syringodium filiforme*), shoal grass (*Halodule wrightii*), paddle grass (*Halophila decipiens*), and Florida Keys grass (*Halophila baillonis*). The distribution pattern for these species is controlled by salinity, light, and air exposure. Generally, shoal grass inhabits the shallowest areas, turtle and manatee grass occupy the intermediate areas, and paddle grass, widgeon grass, and Florida Keys grass grow in the deepest areas. While seagrass cover is most common on sandy or muddy substrate, macroalgae grow in both soft sediments and on hardbottom. Both seagrass and macroalgae are distributed throughout Jobos Bay, providing habitat for commercially and recreationally important fish and invertebrates.

Aguirre LLC conducted multiple surveys of the Project area, including towed-diver video transects and sample quadrats, to characterize the benthic conditions along the proposed subsea pipeline route and within the Offshore GasPort site. The results of these surveys showed that seagrass was the most abundant benthic cover along the pipeline route (see figure 4.4.2-1). Within inshore regions of the Project area, turtle grass had the highest areal extent, followed by macroalgae, paddle grass, manatee grass, and shoal grass (see figure 4.4.2-2). Turtle grass dominates the areas immediately shoreward of the cays, before giving way to a mix of manatee grass, shoal grass, and paddle grass toward the center of Jobos Bay.

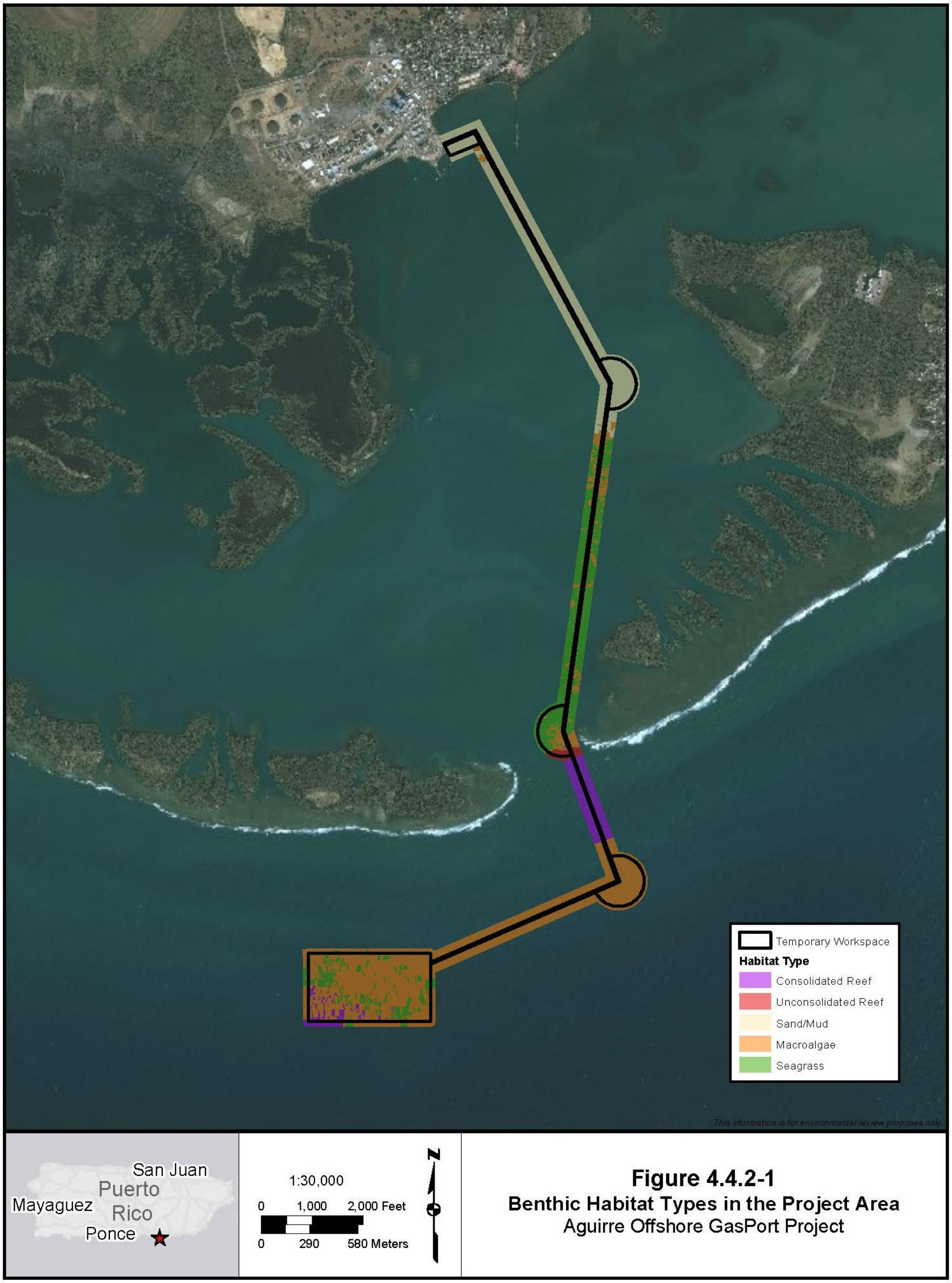


Figure 4.4.2-1
Benthic Habitat Types in the Project Area
Aguirre Offshore GasPort Project

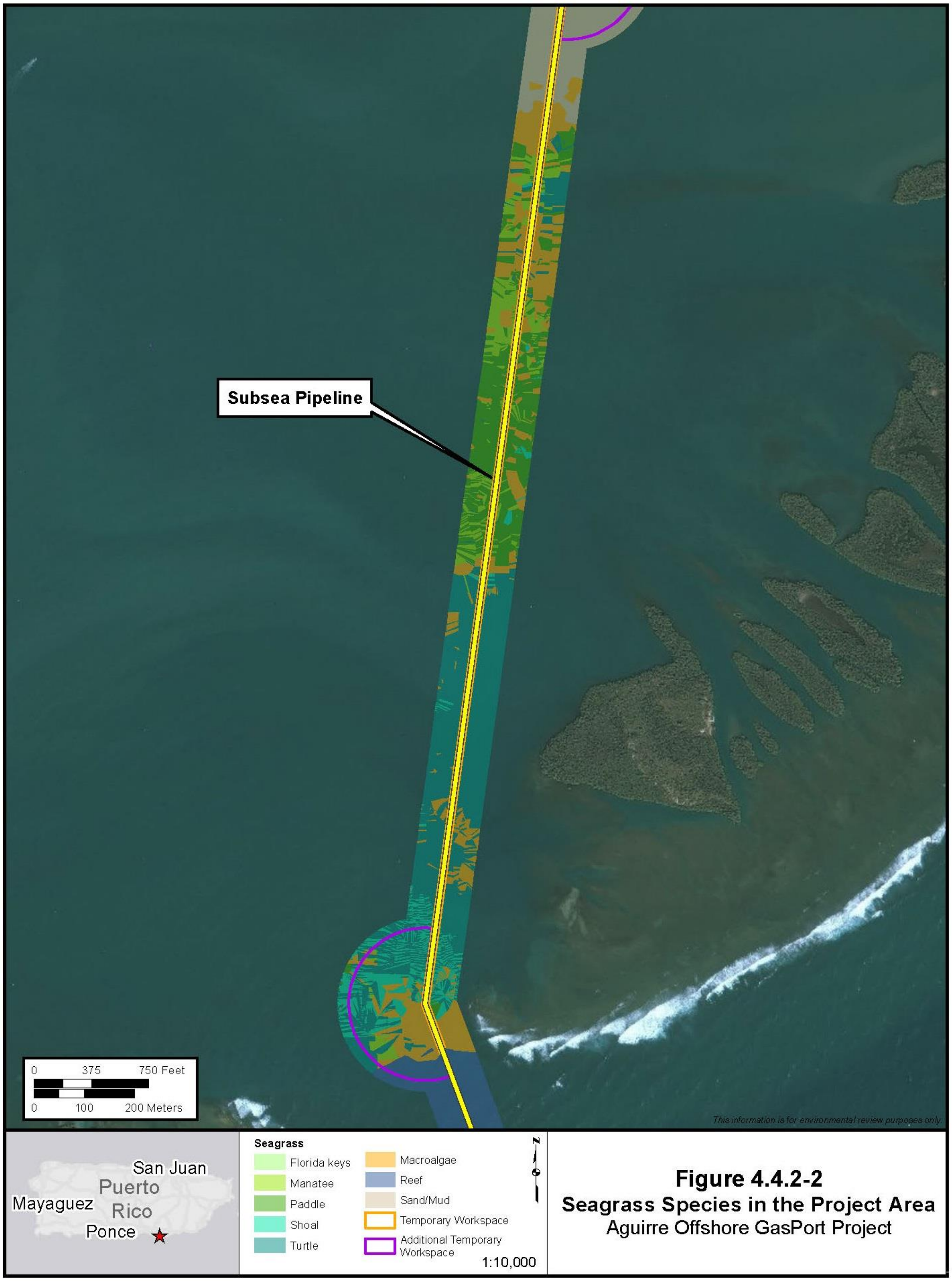


Figure 4.4.2-2
Seagrass Species in the Project Area
Aguirre Offshore GasPort Project

Seagrass was not observed on the southernmost leg of the pipeline route (MPs 0.0 to 1.5). Macroalgae within the Project area had a discontinuous distribution and was intermixed with seagrass in some areas, while occurring as monospecific assemblages in other areas. The most common macroalgae taxon, out of the 39 genera documented, was *Halimeda* spp.

Survey efforts within the Offshore GasPort location revealed three broad-scale benthic communities: macroalgae, seagrass, and patch reef. Macroalgae was the dominant biotic cover and accounted for more than half of the survey area. The seagrass found within in the survey area consisted of large mono-specific Florida Keys grass stands with smaller patches of paddle grass intermixed.

4.4.3 General Impacts and Mitigation

Based on the sparse vegetation within the proposed onshore temporary workspace area, no significant impacts on terrestrial vegetation resulting from construction or operation of the Project are anticipated.

Although no mangroves would be directly impacted by the proposed Project activities, spills or leaks of hazardous materials (e.g., fuel, lubricants) from equipment working in Jobos Bay and offshore areas could result in adverse impacts on nearby mangroves. As described in section 4.3.3.3, construction contractors and port operations personnel would be required to comply with all laws and regulations related to handling of fuels and lubricants, and Aguirre LLC would prepare a site-specific Spill Prevention and Control Plan for construction and operation to minimize the potential for inadvertent release. We are recommending in section 4.3.3.3 that Aguirre LLC file this plan for review and approval prior to construction. Inadvertent hydrocarbon spills in open water areas and associated impacts on the marine environment are discussed in more detail in section 4.5.2.4. Based on the location of the mangroves relative to the Project area we expect impacts on these resources, if any, to be short term and minor.

Construction activities such as vessel anchoring, pipe laying and burying, and pile driving would result in direct impacts on approximately 22.6 acres (23.3 cuerdas) of seagrass and 80.8 acres (83.1 cuerdas) of macroalgal habitat (see table 4.4.3-1). As discussed in section 2.3.4, the majority of the pipeline would be laid directly on the seafloor then lowered by hand jetting/suction method to achieve the required depth. Direct impacts on seagrass and macroalgae were assumed to be within the area of the turbidity curtains Aguirre LLC would utilize during the burial of the pipe. Overall, the turbidity and siltation increases during construction would be temporary in duration and localized in scope (see section 4.2.3.2). Impacts on vegetation resources are expected to be minor and short term with temporary reductions in light penetration that could lower photosynthesis rates and primary productivity in the area.

TABLE 4.4.3-1

Benthic Habitat Types Within the Aguirre Offshore GasPort Project Area

	Seagrass		Macroalgae		Coral Reef		Sand/Mud	
Project Component	Const.	Oper.	Const.	Oper.	Const.	Oper.	Const.	Oper.
Offshore Terminal (acres [cuerdas])	12.0 (12.4)	2.9 (3.0)	59.4 (61.1)	19.2 (19.8)	4.1 (4.2)	0.2 (0.2)	0.0	0.0
Subsea Pipeline (acres [cuerdas])	10.6 (10.9)	0.01 (0.01)	21.4 (22.0)	0.02 (0.02)	2.1 (2.2)	0.4 (0.4)	20.3 (20.8)	0.2 (0.2)
TOTAL(acres [cuerdas])	**22.6 (23.3)**	**2.9 (3.0)**	**80.8 (83.1)**	**19.2 (19.8)**	**6.2 (6.4)**	**0.6 (0.6)**	**20.3 (20.8)**	**0.2 (0.2)**

Note: Const. = temporary impacts during construction (includes operational impacts), Oper. = permanent impacts during operation

As discussed above, several seagrass species are present in or adjacent to the Project area including turtle grass, manatee grass, shoal grass, and paddle grass. Field experiments have shown significant species-specific differences in the duration that seagrasses can tolerate high rates of sedimentation (Cabaco et al., 2008; Erftemeijer and Lewis 2006; Erftemeijer and Shuail, 2012). Significant relationships have been summarized between burial thresholds and root mass, the rhizome diameter, the aboveground biomass, horizontal rhizome elongation, and leaf length of seagrass species (Cabaco et al., 2008). In general, leaf size and rhizome diameter are the best predictors of the capacity of seagrasses to withstand burial (Cabaco et al., 2008). Larger climax seagrass species can survive large accumulations of sediments for periods up to 200 days (Erftemeijer and Shuail, 2012). Smaller opportunistic seagrass species showed mass mortality after burial with levels ranging from 0.8 to 2 inches (20 to 50 mm) of sediment within as little as 35 days; however, these fast-growing species often have high horizontal elongation rates that allow fast recovery after burial (Cabaco et al., 2008; Erftemeijer and Shuail, 2012). Based on the research studies reviewed, manatee grass is the most sensitive species to sedimentation in the Project area. Cabaco et al., (2008) reported that manatee grass has high mortality (80 percent) under low burial levels of 1.6 to 2 inches (40 to 50 mm) for a period of 60 days. For purposes of evaluating sedimentation impacts on seagrasses in the Project area, a sedimentation threshold of 2 inches (50 mm) was used. As discussed in section 4.2.3.2, the sediment transport modeling conducted for the Project showed that maximum sediment deposition was 0.7 inch (1.7 cm) and would decrease to less than 0.04 inch (1 mm) within 200 feet (61 meters) of the pipeline. Therefore, impacts on seagrass are not anticipated beyond the limits of the construction right-of-way.

Construction of the subsea pipeline as outlined in section 2.3.4.1 describes the procedure for welding and stringing of the pipeline. Aguirre LLC proposes to use its crane barge with winch wire to maintain tension on the pipeline in the water column until it is lowered into position on the shallow water segments. For the deep water segments, these pipeline segments will be maintained afloat using buoys until they are ready to pull into position. Either method may experience inadvertent pipe lay on the seafloor. We believe the use of a pipeline lateral guidance system should be used to ensure the floating pipeline remains in the proper position until it is ready to be buried. Flexifloats or similar floats should be maintained to ensure the pipeline does not cause unanticipated damage to the marine environment. To ensure that impacts on seafloor vegetation are minimized, **we recommend that:**

- **<u>During construction</u>, Aguirre LLC should maintain the pipeline segments afloat and avoid contact with the seafloor outside the construction work area until the pipeline is ready for burial.**

Habitat loss due to the placement of concrete mats over the pipeline would result in permanent impacts on approximately 0.01 acre (0.01 cuerda) of seagrass and 0.02 acre (0.02 cuerda) of macroalgae. It is anticipated that seagrasses and macroalgae would recolonize where the pipeline is buried and where there are no concrete mats. Some plants may grow in the sediments that settle within the grooves of the mats; however, it is anticipated that seagrass species that tend to have deep root systems (e.g., turtle grass, manatee grass) would not grow within the mats.

The habitat alteration and shading effects from the operation of the Offshore GasPort would result in permanent impacts on approximately 2.9 acres (3.0 cuerdas) of seagrass and 19.2 acres (19.8 cuerdas) of macroalgae. Seagrass species that would be impacted by shading effects from the Offshore Gasport include Florida keys and paddle grass which are considered smaller, fast growing seagrasses. Variation between different seagrass species in their ability to endure and recover from periods of reduced light is related to their differing morphology and physiological characteristics (Erftemeijer and Lewis, 2006). Smaller fast growing pioneering species do not endure long periods of reduced light once environmental conditions are beyond that which they can adapt (Erftemeijer and Lewis, 2006; Erftemeijer and Shuail, 2012). Paddle grass generally requires less light than most seagrasses and can be found in shallow, turbid areas, and under docks (Fonseca, 1994).

Aguirre LLC's draft Benthic Resources Mitigation Plan is summarized below and included as appendix D. Mitigation measures outlined in the plan include pre-construction surveys in Jobos Bay to map and quantify restoration sites and identify reference sites, seagrass planting and relocation, post-construction surveys to assess and address any potential construction damage, and monitoring of restoration sites and transplant areas.

The draft plan states that pre-construction surveys would identify potential restoration sites for seagrass as well as reference sites for comparison during routine monitoring events. Restoration sites would be identified through coordination with local and regulatory agency staff, resource managers, and JBNERR staff. These sites may include vessel grounding sites, anchor drags, and propeller scar areas within larger areas of existing seagrass. Potential seagrass mitigation sites have been identified within Jobos Bay along the shallow shoals just east of the Aguirre Plant. Site assessments would quantitatively and qualitatively evaluate each feature for appropriateness as mitigation. Pre-construction surveys, using 'towed-diver' methods would document pre-construction conditions of the entire pipeline corridor and offshore area. The results of the survey would be incorporated into a pre-construction benthic characterization report.

Aguirre LLC would conduct post-construction surveys immediately after completion of construction activities to evaluate the pipeline construction corridor and identify any incidental or unanticipated impacts from construction. The surveys would utilize towed divers equipped with cameras to document the post-construction conditions of the benthic habitat.

Seagrass transplanting would include areas of seagrass that would otherwise be permanently impacted by construction activities. Populations of turtle grass, Manatee grass, and paddle grass that would be permanently impacted by pipeline construction would be used as donor plugs (turtle grass and manatee grass) and sods (paddle grass) for seagrass restoration sites. Subtropical seagrass restoration sites have successfully employed donor plug and sod transplanting techniques (Fonseca et al., 1984; Fonseca 1994, Fonseco et al. 1998) Seagrass within the temporary impact area would not be relocated prior to construction; however, seagrass would be transplanted to restoration areas of greater size to provide compensatory mitigation for those impacts. To ensure survivorship and subsequent natural recruitment, Aguirre LLC would relocate seagrasses to an area with similar physiochemical characteristics as the original location. Various tools and handling methods are appropriate for each type of transplant depending upon the conditions at the impact area and recipient sites, the time of year, and the equipment and manpower that are readily available. The various tools and conditions would be evaluated and applied during seagrass transplanting events as described in the draft Benthic Resources Mitigation Plan (see appendix D).

Aguirre LLC would establish transect monitoring stations and record the global positioning system (GPS) coordinates. Transect endpoints would be marked with semi-permanent stakes to allow for positive identification during monitoring events. After the completion of field activities, Aguirre LLC would prepare and submit a Seagrass Mitigation Completion Report to the COE, NMFS, FWS, and DNER. Monitoring of the seagrass mitigation sites would occur within 30 days following transplanting activities and would occur each consecutive August. A monitoring report would be compiled by October after each monitoring event.

To account for overall community-level seagrass flux and for seasonal or storm-related changes, data collected from the mitigation area would be compared to that of the reference site during each monitoring event. Data collected from reference sites would be used to determine appropriate success criteria (target density) for each of the seagrass mitigation sites. Recruitment progress relative to the reference area would be assessed using the one-way GLM ANOVA, a powerful statistical test used to compare means using one dependent variable and multiple independent variables. Mitigation success would be determined by the non-significant difference in seagrass coverage between the mitigation and reference area. Post-mitigation monitoring efforts are proposed for 3 years; however, if success criteria have been reached for any individual components of the mitigation plan, the mitigation would be deemed successful and monitoring activities for these individual areas would cease. If mitigation is not trending toward success an additional 2 years of annual monitoring would be performed.

Based on our review, Aguirre LLC's proposed mitigation measures address permanent impacts on seagrasses that occur within the permanent subsea pipeline footprint; however, impacts on 2.9 acres (3.0 cuerdas) of seagrass potentially affected by shading from the Offshore GasPort were not addressed. In addition, the draft Benthic Resources Mitigation Plan does not reflect the most recent modifications to the proposed action and would need further revision depending on whether the HDD across the Boca del Infierno pass is feasible; or, if not, Alternative Route 6 is constructed. To ensure that permanent impacts on seagrass are minimized and/or properly mitigated, **we recommend that:**

- **<u>Prior to construction</u>, Aguirre LLC should consult with the NMFS, FWS, DNER, and other appropriate agencies to finalize the Benthic Resources Mitigation Plan to address the currently proposed construction and operation impacts and should include the actual pipeline design/route to be constructed. The plan should address the seagrass that would be permanently impacted by shading due to the Offshore GasPort. The updated plan should identify measures, other than additional monitoring, that would be implemented if the mitigation sites are not trending towards successful restoration. In addition, the plan should comply with the standard requirements found in the COE's Compensatory Mittigation Rule under the Clean Water Act Section 404 regulatory program. Aguirre LLC should file its final Benthic Resources Mitigation Plan, along with agency comments, with the Secretary for review and written approval by the Director of OEP.**

4.5 WILDLIFE RESOURCES

Wildlife species inhabiting the Project area are characteristic of the habitats that occur in the vicinity of the Project. Threatened and endangered wildlife species are discussed in section 4.6.

4.5.1 Terrestrial Wildlife Resources

The onshore facilities for the Project would be entirely within the existing Aguirre Plant property. The industrial infrastructure development within the Aguirre Plant has significantly reduced the available upland habitat for wildlife species. Additionally, while other areas surrounding Jobos Bay are considered areas of conservation priority for wildlife species by the Natural Heritage Program, the industrial complex surrounding the Aguirre Plant is excluded from this designation (DNER, 2005). Due to the lack of suitable vegetated habitat and the ongoing industry activities at the site, only urban-acclimated species are likely to inhabit the proposed Project area. Urban acclimated species occurring within the vicinity of the Project area include green iguanas, Brook's house gecko, giant toad, house mouse, black rat, and feral cats and dogs (Ventosa-Febles et al., 2005). Because of the lack of suitable wildlife habitat within the upland area of the Project, bird species within the Project vicinity would likely utilize surrounding estuarine and marine habitats (see section 4.5.3.2) or be acclimated to disturbance.

4.5.1.1 General Impacts on Terrestrial Wildlife Resources

The urban acclimated species within the Aguirre Plant would likely leave the Project area during construction. Noise associated with construction could also disrupt breeding and/or feeding behavior of wildlife in the vicinity of the Project. No additional lighting is proposed at the Aguirre Plant; therefore, wildlife impacts associated with lighting are not anticipated. Animals displaced by construction activities may relocate into similar or higher quality habitats nearby. Additionally, some smaller, less mobile wildlife, such as small mammals, burrowing species, amphibians, and reptiles, could be crushed by construction equipment. However, these effects would cease after construction and any wildlife previously utilizing the Project area would return to the existing industrial area. Because wildlife in the Project area are already acclimated to industrial conditions, we conclude that no significant impacts on wildlife within the upland areas would occur during the construction or operation of the Project.

4.5.2 Marine Benthic Resources

4.5.2.1 Coral Reef

Although coral reefs comprise only about 4 percent (512 acres [527 cuerdas]) of the total benthic habitat in Jobos Bay (Zitello et al., 2008), they are some of the most productive habitats in the area and provide important habitat for fish and invertebrates of commercial, recreational, and ecological value. Corals are often divided into two main types: stony, hard, or "reef-building" corals (Scleractinia) and soft corals or gorgonians (Alcyonacea). Coral cover in inshore areas is relatively low. Most of Jobos Bay's coral reefs are linear in formation, running along cays encircling the central bay. García-Sais et al. (2003) assessed two of these cays, Cayos Caribes and Cayos de Barca, and documented significant amounts (20 to 21 percent) of coral cover. The most common stony corals in Jobos Bay are mustard hill coral, followed by massive starlet coral, great star coral, and boulder star coral. Soft corals exhibit similar coverage patterns as hard corals. Of these, encrusting soft corals are most common in Jobos Bay, followed by sea plumes/rods/whips, and sea fans. Whitall et al. (2011) observed 24 coral species in Jobos Bay, with species richness ranging from 0 to 13 species present at individual sample sites.

Aguirre LLC conducted multiple surveys of the Project area, including towed-diver video transects and sample quadrats, to characterize the benthic conditions along the proposed subsea pipeline route and within the Offshore GasPort site. These surveys documented three zones in the Project area: a backreef zone, consisting mainly of dead coral rubble; a gorgonian (Alcyonacea) zone, consisting mainly of soft corals; and a forereef zone, defined mainly by stony corals (see figure 4.5.2-1). The rubble fragments in the backreef zone were mixed with coarse-grained sand substrate. The substrate within the gorgonian zone and forereef zone was low to moderately rugose consolidated reef. Additionally, in the forereef zone, spur and groove coral formations with sand chutes were observed. Biotic cover in the forereef and gorgonian zone was approximately 85 percent, with turf algae as highest mean percent coverage at 22 percent, and followed by 22 percent macroalgae, 18 percent stony coral, 12 percent soft coral, 7 percent sponge, and 4 percent other algae and biota. During the 2012 survey work, 30 species of stony corals were documented, with starlet coral, symmetrical brain coral, and great star coral accounting for the highest cover. Sixteen species of soft coral were documented, with slimy sea plume accounting for the highest cover. All seven of the coral species that are ESA-listed were observed in the Project area (see section 4.6.1.5). Based on the survey results, Aguirre LLC estimates that there are likely 40,115 total coral colonies within the 20-foot-wide (6 m) pipeline corridor.[9]

[9] Additional information about the coral reef habitat in the Project area is included in Aguirre LLC's ESA Coral Mapping and Demography Report, which can be viewed on the FERC Internet website (http://www.ferc.gov). Using the "eLibrary" link, select "Advanced Search" from the eLibrary menu and enter 20140129-5064 in the "Accession Number" field.

Figure 4.5.2-1
Coral Reef Habitat in the Project Area
Aguirre Offshore GasPort Project

Substrates within the Offshore GasPort location are mainly sand and mud, and lack the hard surfaces necessary for the attachment of reef-building corals. However, survey work identified 4.1 acres (4.2 cuerdas) of patch reef and showed that the coral cover consisted of 11 different species, including two ESA-listed species (see section 4.6.1.5). The most abundant species were rose coral and tube coral. All the corals sampled were small, but well developed. The largest coral sampled was a colony of rose coral that was 1.5 by 3.5 inches (4 by 9 cm), which is typically as large as this species gets in deep, sand flat habitats.

Caribbean coral reefs are under a number of threats, and those of Jobos Bay are no exception. Corals in the area have been subjected to mass mortality due to black band disease, white band disease, coral bleaching, overfishing, and tropical cyclones (Whitall et al., 2011). Additional physical damage has been incurred by anchor and propeller impacts, trampling during snorkeling activities, and water contamination by garbage and engine fuels (García-Saís et al., 2008). Gardner et al. (2003) found that live coral cover in the Caribbean has declined by 80 percent over the last three decades. In addition to these regional stresses, local stresses to Jobos Bay corals include thermal discharges from the existing Aguirre power plant, sewage inputs, agricultural runoff, sedimentation, and mangrove deforestation.

4.5.2.2 Other Invertebrates

Although seagrasses, macroalgae, and coral reefs represent the most typical benthic cover types, other benthic organisms inhabit Jobos Bay which do not fall as neatly into discrete groups or form as continuous cover as the above mentioned cover types. These include sessile invertebrates such as sponges, zoanthids, tunicates, hydroids, and mobile invertebrates such as queen conch, fighting conch, milk conch, spiny lobster, and long-spine sea urchins. The benthic surveys conducted by Aguirre LLC documented 12 queen conch, generally associated with turtle grass between MPs 1.5 to 3.0 of the pipeline route, and many fighting conch, mostly concentrated in the vegetated-mud transition near MP 3.0. Surveys also noted eight milk conch in the forereef and Boca del Infierno pass area, and many long-spine sea urchins in the interface between the backreef rubble and gorgonian zone. Spiny lobsters were rare, with only four specimens observed in the reef and one individual in the offshore patch reef.

The highest occurrence of sponges was documented on the forereef and gorgonian zones, where sponge cover was 7 percent and a total of 47 taxa were observed. Zoanthids and tunicates were relatively abundant in this area as well, each with 0.5 percent cover. Sessile invertebrates, including hydroids, fire corals, and anemones, were also found in relatively high number within the back reef. The patch reefs in the Offshore GasPort area are biologically well developed, with an abundance of stony corals, gorgonians, sponges, and macroalgae. The reef also supports a variety of motile benthic organisms including fish, crustaceans, gastropods, and echinoderms.

4.5.2.3 Other Algae

While macroalgae are common in Jobos Bay, calcareous red algae, also known as crustose coralline algae, are present as well, albeit in fewer numbers. Some species form attachments on hard substrate, and others form unconsolidated, often warty balls that settle in beds. These are known as rhodoliths, and provide habitat for diverse benthic communities. Crustose coralline algae were most frequently observed in the backreef zone. Turf algae were observed in particularly high cover (22 percent) on the forereef and gorgonian zones, although they are present in many areas of Jobos Bay. Turf algae were among the more common cover types in the Offshore GasPort area, at 0.5 percent. Very low amounts of crustose coralline algae were observed in the Offshore GasPort area.

4.5.2.4 General Impact and Mitigation

Construction of the proposed Project, incorporating our recommendations, would result in short-term, minor adverse impacts on benthic resources from hydrostatic testing, sediment resuspension, suction of sediments during pipe lowering procedures, and shading; and short-term, moderate adverse impacts from inadvertent hydrocarbon spills and habitat alteration/loss. As discussed in section 2.3.4, the majority of the pipeline would be laid directly on the seafloor then lowered by hand jetting/suction method to achieve the required depths. Aguirre LLC would locate the end of the suction head below the sediment surface to reduce the chance of collecting benthic organisms during the pipe lowering process. Operation of the Project would result in permanent, minor adverse impacts on benthic resources from shading, scour in areas where concrete mats would be installed above grade, thermal plume discharge from the FSRU and LNG vessels; and permanent, moderate impacts from inadvertent hydrocarbon spills. The Project, as proposed, would also result in permanent, significant adverse impacts from habitat alteration/loss, due to the 0.4 acres (0.4 cuerdas) of coral reef habitat that would be covered with the 8-foot-wide concrete mats along the pipeline and 0.2 acre (0.2 cuerda) at the Offshore GasPort.

Aguirre LLC provided thermodynamic calculations related to the heat transfer from the subsea pipeline to the surrounding seawater during operation. The calculations demonstrated that water flowing past the pipeline would decrease slightly but would return to ambient seawater temperature within 1 inch (2.5 cm) of the surface of the concrete coating. Based on our review of the provided calculations, we agree with Aguirre LLC's determination. These calculations were based on the previous direct lay construction methods, which would have resulted in the pipeline being above grade. Because the majority of the pipeline would now be buried at or below grade, heat transfer in those areas would be less than those calculated for the pipeline above grade. At each PI location, the pipeline would not be concrete coated but would be installed below grade and reinforced with concrete mats. As currently proposed, the portion of the pipeline installed across the Boca del Infierno pass would be above grade but would be coated with concrete and protected using concrete mats. However, we are recommending that Aguirre LLC use an HDD to cross the Boca del Infierno pass; or, if the HDD is infeasible, to construct along an alternative route. In either case, the use of concrete mats would be reduced. Based on the thickness of the concrete mats (9 inches [23 cm]), we do not anticipate that heat transfer from the pipe would impact the ambient seawater temperature at matted locations. We also reviewed the heat transfer for the vertical section of pipeline (riser) from the seafloor to the Offshore GasPort, which we assumed would not be coated in concrete. Our calculations showed that the temperature of the water flowing past the riser would also return to ambient temperatures within 1 inch (2.5 cm) of the riser. Even under the most conservative assumptions, water would return to ambient temperatures within several inches or less, with the majority of the temperature change occurring within 1 to 2 inches (2.5 to 5 cm) of the pipeline. Therefore, thermal stress associated with the pipeline is not discussed in the remainder of this document.

Hydrostatic Testing

Hydrostatic testing involves filling pipelines with water, performing pressure tests in accordance with applicable regulations, and discharging the test water following completion of the test. Aguirre LLC would withdraw the water used for testing from Jobos Bay or the Caribbean Sea, depending on the section of pipeline being tested. The intake rate would be between 14,900 and 22,500 gallons per hour (56 to 85 m^3/hr). The water intake would be about 6 feet below the surface and would be fitted with a 100-micron mesh screen to minimize the entrainment of fish and other organisms. NMFS raised concerns regarding entrainment of fish during this process. To ensure that the entrainment of fish and other organisms is minimized or avoided, **we recommend that:**

- **<u>Prior to construction</u>, Aguirre LLC should consult with NMFS regarding the type of screen (e.g., wedge-wire) that should be used for hydrostatic test water withdrawals during the construction of the Project. The results of this consultation should be filed with the Secretary for review and written approval by the Director of OEP.**

Hydrostatic testing would require about 240,000 gallons of water (909 m^3) to fill the pipeline and complete one full hydrostatic test. Under normal circumstances, only one test event would be required, but there is a possibility that retesting of the pipeline could be required. Following completion of a testing event, Aguirre LLC would discharge the untreated seawater to Jobos Bay at the shore approach. The water would be discharged at least 6 feet (2 m) below the water surface through a pipe fitted with a diffuser head to reduce discharge velocity and minimize impacts on the bottom sediment.

Benthic cover at the shore approach is almost exclusively macroalgae (estimated at 14 percent cover), growing in silty or muddy substrate. Thus, impacts would likely be minor and limited to local mortality in the immediate discharge area. Macroalgae would likely recolonize areas affected by the discharge in a matter of weeks to months. Resuspended sediment would reduce light availability for macroalgae and seagrasses in a more widespread area beyond the immediate discharge area; however, this impact would be temporary (generally limited to a one or two time event) and localized to the discharge location.

Sediment Resuspension

An increase in turbidity due to sediment resuspension from installation of the proposed moorings and pipeline has the potential to cause short-term minor adverse effects on benthic resources. Impacts associated with sediment resuspension also include reduced filtering efficiencies in certain invertebrates, potentially impacting their growth and survival, and decreased foraging efficiency of visual predators. Benthic substrates beneath the proposed terminal site are predominately coarse sands, which would settle quickly and not be subject to prolonged transport. Burial of the pipeline using hand-jetting/suction techniques would result in the resuspension of finer sediments, but the increased turbidity is expected to be minor. Aguirre LLC would use a diffuser head fixed to the pump in combination with turbidity curtains to help redirect a majority of the suspended sediments back to the construction right-of-way (see section 2.3.4). However, the transport of fine sediments beyond the construction right-of-way would likely occur. Section 4.2.3.2 describes the projected sediment transport associated with the proposed construction methods without the use of turbidity curtains.

Coral reefs may be particularly sensitive to sediment impacts, which include smothering, burial, and shading of the coral polyps. Increased sedimentation rates can lead to direct impacts on corals such as influencing growth rates, metabolism, and fecundity (Erftemeijer et al., 2012). However, coral species have developed some defense mechanisms to sedimentation. Riegle (1995) found that hard bottom coral species are able to withstand episodic deposition of about 1.0 ounce per square foot (oz/ft^2) (31 milligrams per square centimeter [mg/cm^2]) of sediment (equivalent to a deposition layer of about 0.04 inch (0.1 cm)), but showed stress responses or death when exposed to continuous deposition at this rate. Riegle (1995) also found that hard coral are able to eject and remove sediment at rates ranging from about 0.006 oz/ft^2 to 0.02 oz/ft^2 (0.2 to 0.7 mg/cm^2) per minute. At this rate, coral could remove a layer measuring 0.04 inch (0.1 cm) thick in less than 3 hours. Riegle's study was conducted in a laboratory; however, parallel observations in the field and local community structure data supported the laboratory findings (Riegle, 1995). The laboratory environment simulated extreme conditions, such as high sedimentation and practically zero water motion in which the corals' attempts at sand clearing were completely unaided; therefore, the study represented the worst possible case for corals. Based on the sediment transport modeling conducted for the Project (see section 4.2.3.2), which was calculated for construction without the use of turbidity curtains, a deposition thickness of 0.04 inch (0.1 cm) within the coral reef habitat crossed by the Project in the Boca del Infierno pass would be limited to within 200 feet (61 m) of the reef edge. As discussed in section 2.3.4, Aguirre LLC would utilize hand jetting/suction techniques with turbidity curtains to lower the pipeline in areas adjacent to the coral reef. The turbidity curtains would minimize sedimentation transport during pipeline construction activities, which we anticipate would reduce the deposition levels within the reef to below 0.04 inch (0.1 cm). To ensure the effectiveness of the turbidity curtains**, we recommend that:**

- **Aguirre LLC should file <u>with its Implementation Plan</u> the protocol that it would use to determine the effectiveness of the turbidity curtains during construction. The protocol should outline the monitoring that Aguirre LLC would conduct, thresholds that it would establish to define effectiveness, and the measures that it would implement if the turbidity curtains are ineffective.**

Erftemeijer et al. (2012) reviewed 77 published studies on the effects of turbidity and sedimentation on 89 different coral species. A review of published literature on the sensitivity of corals to turbidity determined that tolerance limits of coral reef systems for chronic suspended-sediment concentrations range from less than 10 mg/L in pristine offshore reef areas to more than 100 mg/L in marginal nearshore reefs (Erftemeijer et al., 2012; Erftemeijer and Shuail, 2012). The duration that corals can survive high turbidities ranges from several days for sensitive species to at least 5 to 6 weeks for tolerant species (Erftemeijer et al., 2012). The minimum threshold used for evaluating the sedimentation effects of coral populations in and surrounding the Project area was 10 mg/L. Based on the sediment transport modeling conducted for the Project, sediment concentrations (mostly fine sediments) of 10 mg/L would extend 85 feet (26 m) from the construction right-of-way into the reef (see section 4.2.3.2). This would represent 0.4 acre (0.4 cuerdas) of impact within coral reef habitat if no turbidity curtains were used. We anticipate that Aguirre LLC’s utilization of turbidity curtains would significantly reduce turbidity levels and would limit turbidity impacts on coral reef to the construction right-of-way.

Overall, turbidity increases during construction would be temporary in duration and localized in scope, so the impact on benthic resources is expected to be minor and short term. As discussed in section 2.3.4, the lowering procedures would be controlled to mitigate dispersion of excavated sediment. Turbidity curtains placed around the sediment discharge locations would help to further reduce sedimentation and water quality impacts. The majority of the impacts associated with sediment resuspension and transport would be limited to the time required to lower the pipe. Aguirre LLC anticipates about 10 days would be required to bury each pipeline segment to the proper depth.

However, where the pipeline would be above grade (MPs 1.0 to 1.6), and at each permanent piling, persistent siltation and turbidity from scour and sediment deposition may occur, reducing light penetration and lowering photosynthesis rates and primary productivity in the area. Persistent siltation and turbidity from scour and sediment deposition between MPs 1.0 to 1.6 is anticipated to be minimal due to the hard bottom sediments in that area. In addition, the concrete mats would potentially capture and retain some sediments. Where the pipeline is buried at or below grade, persistent siltation and turbidity impacts are not anticipated. Water discharges from the LNG carriers could also cause sediment resuspension at the Offshore GasPort during operation. Turbidity increases associated with scour around the section of pipeline between MPs 1.0 to 1.6, at the permanent pilings, propeller wash, and the LNG carrier discharges would be localized in scope, so the impact on benthic resources is expected to be permanent but minor.

Inadvertent Hydrocarbon Spills

Minor releases of hydrocarbons (e.g., LNG, fuel, and lubricants) during construction could result in short-term, minor to moderate adverse impacts on benthic resources. Spills could originate from accidental spills from construction barges or support boats, loss of fuel during fuel transfers, or accidents resulting from collisions. The impacts of hydrocarbons are caused by either the physical nature of the material (e.g., physical contamination and smothering) or by its chemical components (e.g., toxic effects and bioaccumulation). These impacts would depend on the depth and volume of the spill, as well as the properties of the material spilled.

As described in section 4.3.3.3, construction contractors and port operations personnel would be required to comply with all laws and regulations related to handling of fuels and lubricants, and Aguirre LLC would prepare a site-specific Spill Prevention and Control Plan for construction and operation to minimize the potential for inadvertent release. We are recommending in section 4.3.3.3 that Aguirre LLC file this plan for review and approval prior to construction.

Habitat Alteration/Loss

Construction activities such as vessel anchoring, platform construction, and pipeline laying would result in direct impacts on approximately 22.6 acres (23.3 cuerdas) of seagrass, 80.8 acres (83.1 cuerdas) of macroalgae, and 6.2 acres (6.4 cuerdas) of coral reef habitat, including approximately 4.1 acres (4.2 cuerdas) of patch reef in the vicinity of the Offshore GasPort (see table 4.4.3-1). Generally, seagrasses can recover from damage to leaves but not from damage to roots. Coral growth rates have been observed to range from 2 to 5 percent per year (Osborne et al., 2011); thus, recovery of damaged or destroyed coral assemblages may be on the order of decades. Aguirre LLC would address in its Benthic Resources Mitigation Plan the recovery of seagrasses and coral to ensure appropriate mitigation.

As requested in the draft EIS, Aguirre LLC conducted additional work to determine the feasibility and risk of installing the pipeline through the Boca del Infierno pass, where a majority of the coral impacts would occur, using the HDD construction method. Based on a review of the geotechnical subsurface data and the preliminary nearshore geotechnical investigation report prepared by Golder Associates, Aguirre LLC determined that a successful HDD of this area would likely be infeasible based on the subsurface geotechnical data currently available. Aguirre LLC's contractor concluded that a detailed sub-surface exploration program would be required to determine the feasibility of an HDD to cross the Boca del Infierno pass. To ensure that impacts on coral reef habitat are minimized or avoided to the extent practicable, w**e recommend that:**

- **Aguirre LLC should file <u>with its Implementation Plan</u> the geotechnical analysis for the HDD of the Boca del Infierno pass and provide its assessment on whether the HDD would be a viable construction method for avoiding the pipeline's impacts on the coral reef habitat. To ensure impacts are minimized on the coral reef habitat, Aguirre LLC's assessment should discuss the feasibility of an HDD based on the substrate that would be crossed, including but not limited to mitigations measures such as the use of casings to minimize the likelihood of an inadvertent release, turbidity curtains to minimize sediment transport, and barges to collect drilling mud.**

Habitat loss due to the placement of concrete mats over the pipeline would result in permanent impacts on approximately 0.01 acre (0.01 cuerda) of seagrass and 0.02 acre (0.02 cuerda) of macroalgae, 0.2 acre (0.2 cuerda) of sand and mud habitat, and 0.4 acre (0.4 cuerda) of coral reef habitat. It is anticipated that seagrasses and macroalgae would recolonize where the pipeline is buried and where there are no concrete mats. In addition, some plants may grow in the sediments that settle within the grooves of the mats, which could encourage colonization of the mats by benthic organisms.

The ability for coral species and other benthic resources to utilize the concrete mats in the Boca del Infierno pass and within Jobos Bay is unknown. According to the *Coral Reef Restoration Handbook*, utilization of articulated concrete mats, similar to those proposed for the Project, did not perform as expected when reviewing restoration activities designed to restore injured resources and services to the pre-injury condition (Precht, 2006). A 1997 coral reef restoration project, in response to impacts associated with a vessel grounding off the Florida Keys, monitored restoration activities over a 10-year period. Monitoring focused on biological recovery, recruitment, and physical stability. Concrete mats were used to try to stabilize unconsolidated substrates in the vicinity of the vessel grounding area on two low relief coral spurs. In spite of engineering analysis supporting their stability, some of the mats moved and broke apart under storm conditions, including Hurricane George. Precht (2006) stated that one factor in this failure was that the edges of the mats were not properly secured to the substrate and that the mats should have been secured into the limestone using stainless steel eyebolts and cemented with epoxy or other adhesive. Evidence showed that during storm events (including Hurricane George), substantial erosion occurred beneath the edges of the mats, allowing wave action to lift the edges causing movement (Precht, 2006). When segments became detached, they could become strewn about the area causing additional injury to the surrounding coral reef community. Ultimately, the mats themselves did not provide three-dimensional habitat necessary for biological restoration (Precht, 2006). The conclusion drawn was that if mats could be secured to the substrate, the articulated mats may serve the purpose of stabilization of the underlying substrate (Precht, 2006). Aguirre LLC proposes to secure each end of the mats in the Boca del Infierno pass with double mats fixed with helix screw anchors screwed into the seabed and secured to the concrete mats with stainless steel clamp connectors. However, where mats are installed in other locations along the subsea pipeline, the mat edges would be lowered into the natural sediments using hand-jetting techniques as a way to secure the 6,000-pound concrete mats to the seafloor. To ensure that the concrete mats remain securely on the seafloor during Project operations, **we recommend that:**

- **Aguirre LLC should file <u>with its Implementation Plan</u> a description of the measures that would be used, in addition to lowering the mat edges, to secure all the concrete mats to the seafloor.**

The habitat beneath the Offshore GasPort would be permanently altered by shading and the thermal plume discharge, which are discussed more below. The habitat alteration and shading effects from the operation of the Offshore GasPort would result in permanent impacts on approximately 2.9 acres (3.0 cuerdas) of seagrass, 0.2 acres (0.2 cuerda) of patch reef with live corals, and 19.2 acres (19.8 cuerdas) of macroalgal habitat. We conclude the impact of the proposed terminal location on benthic habitat would be permanent and, without proper mitigation, these impacts could be significant because there would be a permanent change in the benthic community in this location.

Aguirre LLC has prepared a draft Benthic Resources Mitigation Plan in consultation with the DNER, NMFS, FWS, and PREPA to offset impacts from construction and operation of the Project on benthic resources including seagrass communities, coral reef habitat, and essential fish habitat. The objectives of the plan are to further avoid and minimize impacts on epibenthic flora and fauna by transplanting seagrass and relocating coral species, including ESA-listed corals, from within the construction footprint prior to construction, to provide mitigation for loss of critical habitat for *Acropora* spp., provide mitigation for impacts on foraging habitat for the green sea turtle and Antillean manatee, and to offset impacts on essential fish habitat. Mitigation proposed for impacts on seagrass populations along the Project are discussed in detail in section 4.4.3. A summary of mitigation proposed for impacts on coral resources is provided below.

Aguirre LLC's proposed draft mitigation measures for impacts on coral reef habitat in the Project area include:

- pre-construction surveys to identify potential coral cache, restoration, and relocation sites;

- pre-construction removal of all ESA-listed coral species from the 20-foot-wide permanent right-of-way and relocation of corals to reef habitats on appropriate and available substrate adjacent to the pipeline at a similar depth contour[10];
- artificial reef construction within Jobos Bay to mimic existing inshore reef habitat;
- offshore artificial patch reef construction for relocation of ESA-listed corals that may be impacted by the Offshore GasPort;
- post-construction surveys to assess incidental damage to corals during pipeline installation for immediate relocation; and
- monitoring of relocated corals and artificial reefs for a minimum of 3 years.

Coral cache sites would serve as a temporary (during construction) staging area for stony corals that would be displaced during construction activities and returned to their original location following construction. Restoration sites would be identified through coordination with local regulatory agency staff, resource managers, and JBNERR staff and would focus on areas in need of restoration in the vicinity of the Project. Site assessments would quantitatively and qualitatively evaluate each feature for appropriateness at mitigation. Aguirre LLC would identify and map restoration areas, reference sites, and coral cache locations using GPS equipment. A description of preliminary relocation sites and artificial reef sites is included in the draft Benthic Resources Mitigation Plan (see appendix D).

Pre-construction surveys would also document pre-construction conditions of the pipeline corridor and offshore area. Aguirre LLC would use towed-diver survey methods and incorporate the survey results into a pre-construction benthic characterization report. This report would help confirm if there were any major changes in benthic communities since the previous surveys were performed.

Aguirre LLC would conduct post-construction surveys immediately after completion of construction activities and would evaluate the pipeline construction corridor to identify any incidental or unanticipated impacts from construction. The surveys would utilize towed divers equipped with cameras to document the post-construction conditions of the benthic habitat.

The boundaries of the potential impact area would include a 20-foot-wide pipeline corridor, which Aguirre would delineate prior to construction. Prior to construction activities, the delineated area would be cleared of all ESA corals and non-ESA corals greater than 10 inches [25 cm] in size. The collected corals would either be cached during construction activities for post-construction relocation back to the pipeline corridor or permanently relocated to an adjacent reef outside any influence of construction with similar substrate and depth contour. Caches would be marked with a surface buoy and GPS coordinates recorded to aid in site relocation. Selected corals would be manually relocated and placed upright within the cache area. Biologists with knowledge and experience in coral reef habitats and species identification would identify and relocate viable relocation candidates. Information summarizing coral reattachment methods is further described in the draft Benthic Resources Mitigation Plan (see appendix D). The biologists would etch a rubber tag with a number and install it in a central location within each reattachment area, collect GPS coordinates and photographs, and produce a polar plot with the relative locations and sizes of the reattached biota.

In order to offset permanent loss of reef habitat within the pipeline footprint, Aguirre LLC proposes to construct inshore artificial reef habitat to offset the critical habitat loss for ESA-listed stony

[10] We believe that relocation of the corals that would be displaced by the concrete matting is not a preferred method of protecting this sensitive resource, including federally listed species. This is one of the driving factors for our recommendations—to completely avoid the most sensitive and concentrated area of federally listed corals in the Project area (e.g., the Boca del Infierno pass).

corals. The inshore artificial reef would be a low relief structure comprised of limestone boulders. It would be designed to mimic the existing inshore reefs at similar water depth and height. To offset potential impacts from shading from the Offshore GasPort on ESA-listed coral species, Aguirre LLC would deploy artificial patch reefs in the offshore vicinity of the Project. These proposed patch reefs would be the recipient site for ESA corals relocated from potentially shaded areas.

After completion of mitigation activities, Aguirre LLC would prepare a coral mitigation completion report and submit it to the COE, NMFS, FWS, and DNER. The report would include an introduction and descriptive and quantitative summaries of the mitigation activities conducted, as well as maps and photo-documentation. Monitoring of the coral mitigation sites would occur within 30 days following relocation activities and would occur each August with a monitoring report due by October of the same year. Post-mitigation monitoring efforts are proposed for 3 years; however, if success criteria have been reached for any individual component of the mitigation plan, the mitigation would be deemed successful and monitoring activities for these individual areas would cease. If mitigation components are not trending towards success, an additional 2 years of monitoring would be performed. Success of the coral relocation to the mitigation areas would be based on the following criteria: after 2 years, survival of 75 percent for corals measuring 4 to 10 inches [10 to 25 cm] and 85 percent for corals measuring greater than 10 inches [25 cm]. If efforts are less than the success criteria, Aguirre LLC would compare the relocated coral survival rates to the survival rates of reference sites and test for statistically significant differences. If the percent of survival of a coral species is below these levels, additional corals of the same species would be transplanted using corals found detached (corals of opportunity) in natural communities or other approved sources. Additional success criteria and coral monitoring activities are outlined in the Benthic Resources Mitigation Plan (see appendix D). The draft Benthic Resources Mitigation Plan has addressed permanent and some temporary impacts on coral reef populations. Any corals that are relocated would need to be approved by NMFS. As summarized in section 4.4.3, we are recommending that prior to construction of the Project Aguirre LLC should finalize the plan in consultation with the appropriate agencies.

Because the majority of the pipeline would be buried at or below grade, we do not anticipate that these buried segments of pipeline would present a barrier to migration for conch, urchins, sea cucumber, and other mobily impaired benthic organisms. However, as proposed by Aguirre LLC, from MPs 1.0 to 1.6 (1,700 feet [518 m]) the pipeline would be directly laid on the surface of the seafloor (hard sediments) and covered with a single layer of concrete mats beside the ends where two mats would be layered. In addition, at the nearshore approach (1,299 feet [396 m]) and at each PI location, the buried pipeline would receive a single layer of concrete mats that would have their ends tapered into the natural sediments leaving a majority of the mats exposed on the surface of the natural seafloor. These areas where the pipeline and/or concrete mats would be above grade may present a barrier to migration for conch, urchins, sea cucumber, and other mobily impaired benthic organisms. This potential barrier could present a permanent, minor impact for these species. However, these species are generally able to traverse voids or hills along the substrate within Jobos Bay where the topography is not completely flat and would likely be able to move around the areas with mats and cross the buried portions of the pipe. The concrete mats may act as a bridge over the pipeline for these mobily impaired benthic organisms in the Boca del Infierno pass. Spiny lobsters are capable of swimming, and thus would likely be less affected by the segment of pipeline that would be directly laid on the seafloor or where the concrete mats are placed just above grade with the natural seafloor. In any event, our recommendations for either crossing the Boca del Infierno pass via HDD or routing to avoid this area would greatly reduce the possibility of the pipeline acting as a migration barrier. However, to ensure that impacts on conch, urchins, sea cucumber, and other mobily impaired benthic organisms are minimized, **we recommend that:**

- **<u>Prior to construction</u>, Aguirre LLC should update the Benthic Resources Mitigation Plan to include 5 years of post-construction monitoring of the areas where the**

pipeline and/or concrete mats are above grade to determine if the mats are preventing the migration of conch, urchins, sea cucumbers, and other less mobile benthic organisms.

Shading

During construction, barges would be utilized in the Project area, resulting in temporary potential shading impacts on SAV and corals. The barges would be approximately 250 feet (76 m) long by 75 feet (23 m) wide, resulting in a shaded area of approximately 0.4 acre (0.4 cuerda) per barge. To minimize potential shading impacts, Aguirre LLC would limit its barge operations near MPs 1.0 and 3.0, where coral reef habitat is not present and SAV abundance is low. With the exception of the pipe lay barge stationed near PI 4 (MP 3.0), barges would not remain in a single location for more than 6 days. Seagrasses have particularly high light requirements, and may begin to experience physiological impacts after several days of shading. Potential shading impacts on corals could result during pipeline and concrete mat installation. Prior to construction, Aguirre LLC proposes to relocate viable ESA-listed stony coral species that would be permanently impacted by the pipeline to minimize impacts as outlined in the draft Benthic Resources Mitigation Plan (see appendix D). However, non ESA-listed coral species may be impacted by the shading.

There is also the potential for shading of corals and SAV during construction and operation of the Offshore GasPort from the platform structure itself. Based on the benthic characterization study conducted by Aguirre LLC, bottom cover in the vicinity of the proposed terminal location consists of approximately 16 percent seagrass, 79 percent macroalgae, and 5 percent stony coral. We conclude that the impacts of shading would be minor during construction due to the short-term nature of the construction activities, the lower cover of SAV in the areas of potential shading, and the proposed mitigation for ESA-listed stony coral species. However, shading from the Offshore GasPort during operation would result in permanent impacts on seagrass and coral reef habitat. Aguirre LLC developed a draft Benthic Resources Mitigation Plan (see appendix D) that would relocate and monitor ESA-listed stony coral species to an artificial offshore reef within the vicinity of the Project to reduce adverse impacts on coral species. In section 4.4.3 we are recommending that Aguirre LLC expand the plan to include mitigations measure for the shading impacts on seagrasses at the Offshore GasPort**.**

Thermal Plume Discharge – Offshore Berth

The environmental setting can have a pronounced influence on the potential for and the magnitude of adverse thermal impact on biota (EPA, 2014c). In sub-tropical waters, temperatures have less seasonal variation, and a more consistent thermal gradient is maintained between discharge and ambient conditions (EPA, 2014c). Marine waters generally constitute a greater thermal reservoir than freshwater systems due to larger volume and tidal flushing (EPA, 2014c). Adverse effects to aquatic organisms are generally most pronounced at the acute and chronic high lethal temperatures and/or due to rapid fluctuations (EPA, 2014c).

Operation of the proposed FSRU would result in heated cooling water discharges from the Main Condenser Cooling System and the Auxiliary Seawater Cooling Service. Thermal plume discharges would also result from the LNG carriers when offloading LNG at the terminal. Based on previous projects, the thermal discharges from the FSRU are assumed to be approximately 21.6 °F (12.0 ºC) above ambient temperature, and the discharges from the LNG carriers are assumed to be approximately 5.4 °F (2.8 °C) above ambient. Assuming an ambient temperature of 85.3 °F (29.6 °C), this translates to a discharge temperature of about 106.9 °F (41.6 °C) from the FSRU and about 90 °F (32 °C) from the LNG carriers.

Thermal plume modeling conducted by Aguirre LLC predicts that the discharges from the FSRU and LNG carriers would meet Puerto Rico's maximum temperature criterion of 90 °F (32 °C) at a maximum horizontal distance of 23.4 feet (7.1 m) and 25.4 feet (7.7 m), respectively, under minimal current conditions (see section 4.3.1.3). The modeling predicted the plume from the FSRU discharges would dissipate beneath the hull and would not reach the seafloor. However, the discharge form the LNG carriers is predicted to reach the seafloor. Water temperature at this plume-substrate interface is anticipated to be approximately 86 °F (30 °C), just below Puerto Rico's maximum temperature criterion.

Over time, the discharge plume from the LNG carriers would displace finer sediment materials (less than 1 mm) away from the site and the concentration of coarser materials would increase at the seabed surface. This transition to coarser sands would permanently alter the composition of the benthic community at the proposed terminal site, favoring burrowing, infaunal species that construct enforced burrows, rather than species using unconsolidated excavated burrows. Studies addressing impacts associated with power plant thermal plume discharges show that growth rates and spawning times of benthic species are usually accelerated by increased temperature (EPA, 2014c). A 1984 study by S. L. Coles was reviewed by the EPA in their *2014 Benefits Analysis for the Final 316(b) Existing Facilities Rule* which found a positive effect with power plant thermal effluent because both the number of benthic organisms and the colonization by coral reef propagules near an outfall were significantly greater than background areas (EPA, 2014c). Although this 1984 study by S. L. Cole showed some beneficial effects of thermal effluent on coral populations, several studies have documented the bleaching and destruction of coral reefs by elevated thermal effluent (reviewed in EPA, 2014c). These studies indicate that thermal discharges substantially alter the local abundance and structure of aquatic communities, particularly benthos and periphyton. Phytoplankton community taxonomic structure near thermal outfalls can be altered as an indirect effect of thermal discharge and, in general, support different communities of algae than those present in the background waters.

Overall, the thermal plumes associated with the proposed action would be restricted to a relatively localized area, so the impact on benthic resources is anticipated to be permanent but minor. To minimize impacts on ESA-listed coral species, prior to construction Aguirre LLC proposes to relocate viable ESA-listed stony coral species that could be impacted by a thermal plume associated with the LNG carriers as outlined in the draft Benthic Resources Mitigation Plan (see appendix D).

Anti-fouling Agents

To prevent macrofouling of the FSRU's raw water intake systems, the FSRU would utilize its on-board copper-aluminum anode MGPS. The system comprises a paired copper anode and an aluminum anode mounted in-line with the seawater intake system, connected to a control box that emits a direct electrical current to the anodes. This system allows a controlled release of copper and aluminum ions that coat the FSRU's seawater piping and prevents settlement of fouling organisms, inhibits corrosion, and results in increased operating efficiency. The MGPS would release, on average, 2 ppb of copper ions at the beginning of the system, which is below the EQB Class SB/SC water quality standard of 3.73 ppb for copper discharge. Copper levels are expected to be lower than 2 ppb at the discharge location due to the copper ions coating the linings of the FSRU piping.

Copper is a trace element needed at miniscule levels for the proper functioning of all organisms; however, it can be toxic at higher concentrations. Organisms have different mechanisms by which they cope with and process copper. Generally, copper is actively regulated in fish, decapod crustaceans, and algae (Guardiola et al., 2012). It is stored in bivalves, barnacles, and aquatic insects (Guardiola et al., 2012). Phytoplankton species have different sensitivities to copper toxicity: resistant (diatoms), intermediate sensitivity (Coccolithophore and dinoflagellates), and most sensitive (cyanobacteria; Guardiola et al., 2012).

Copper is an effective biocide used to deter or kill the microorganisms responsible for biofouling. However, it may also affect non-target organisms and cause environmental concerns. The toxicity of copper in water is greatly affected by the chemical form and to what degree it is bound to various ions or molecules that may be in the water, making the copper unavailable to organisms (Guardiola et al., 2012). Water chemistry influences the bioavailability, biodistribution to various parts of the organism, and bioaccumulation of copper in organisms. When copper oxide enters water as a free copper ion (Cu^{+}) it can immediately oxidize to cupric ion (Cu^{2+}) which can form complexes with inorganic and organic ions or molecules. Copper bound to organic matter is widely thought to be non-bioavailable and, therefore, non-toxic. Numerous studies have shown that most of the copper present in marine environments is not present as cupric ion, which is most responsible for copper toxicity. Most of the dissolved copper is complexed with organic and particulate material in marine environments, which can reduce or completely remove its ability to be taken up by organisms (its bioavailability) and, consequently, its toxicity to marine organisms (Guardiola et al., 2012).

The MGPS would release copper effluent at the FSRU within the EQB Class SB/SC water quality standard for copper discharge. Therefore, the resulting concentrations of copper effluent are not expected to cause adverse effects on the marine benthic communities in response to using this preventative measure to reduce biofouling of the FSRU system.

Scour

Over time, hydrodynamic forces along the pipeline where it would be above the natural seafloor grade and covered by concrete mats, at the platform piles, and potentially where concrete mats would be at the nearshore approach and the PI locations, would result in some level of scouring, which would permanently alter the composition of the benthic community. However, this scouring would be limited to areas directly adjacent to the concrete mats and pilings. Therefore, the impact of scour on the benthic community is anticipated to be permanent but minor.

4.5.3 Marine Wildlife Resources

Marine wildlife species, such as marine mammals, sea turtles, fish, and marine invertebrates inhabit the Project area. Fisheries within the Project area are discussed in section 4.5.5 and invertebrates are discussed in section 4.5.2. Threatened and endangered species are not specifically discussed in this section; however, many of the impacts would be the same as those described below. Threatened and endangered species are discussed in section 4.6.

4.5.3.1 Marine Mammals

The MMPA established, with limited exceptions, a moratorium on the "taking" of marine mammals in waters or on lands under U.S. jurisdiction. The act further regulates, with certain exceptions, the "take" of marine mammals on the high seas by persons, vessels, or other conveyances subject to the jurisdiction of the United States.

The range of distribution extends within the coastal and offshore waters of southern Puerto Rico for 8 species of whales and 12 species of dolphins protected under the MMPA (NMFS, 2013b). A list of these species is provided in table 4.5.3-1. Several of the marine mammal species described below are found in certain water depths either along coastal environments and/or in the open ocean. The water depth near the Offshore GasPort ranges from 60 to 65 feet (18 to 20 m) at mean low water. The water depth gradually increases to 98 feet (30 m) approximately 4 miles (6.4 km) south of the Offshore GasPort site, at which point the water depth rapidly increases to over 1,500 feet (460 m) (NOAA, 2003; NOAA, 2013a).

Unpublished data submitted during the draft EIS public comment period summarized marine fauna research off the coast of Puerto Rico (NMFS permit number 15682) conducted during the winter from 2011 to 2014 (MacKay, 2014). The preliminary findings of this research concluded that Atlantic spotted dolphins, Risso's dolphins, Spinner dolphins, and striped dolphins have been observed frequently off the west coast of Puerto Rico, and opportunistically off the south coast of Puerto Rico. The research also found that short-finned pilot whales have been observed off the west coast of Puerto Rico and orcas have been observed off the south coast of Puerto Rico (MacKay, 2014).

Only two marine mammal species were documented within the Project area during surveys conducted by Aguirre LLC: the Antillean manatee and the bottlenose dolphin. The Antillean manatee is a federally listed species and is discussed in detail in section 4.6.1.1. The bottlenose dolphin is discussed below.

TABLE 4.5.3-1

Non-ESA-Listed Marine Mammals Potentially Occurring in the Aguirre Offshore GasPort Project Area

Mammal	Portion of Project Area where Mammal May Occur [a]	Mammal	Portion of Project Area where Mammal May Occur [a]
Dolphins		**Whales**	
Atlantic spotted dolphin	Jobos Bay and Offshore	Blainville's beaked whale	Offshore
Bottlenose dolphin	Jobos Bay and Offshore	Bryde's whale	Offshore
Clymene dolphin	Offshore	Cuvier's beaked whale	Offshore
Frasier's dolphin	Offshore	Dwarf sperm whale	Offshore
Melon-headed whale	Offshore	Gervais' beaked whale	Offshore
Orca	Offshore	Minke whale	Offshore
Pantropical spotted dolphin	Offshore	Pygmy sperm whale	Offshore
Pygmy killer whale	Offshore		
Risso's dolphin	Offshore		
Rough-toothed dolphin	Offshore		
Short-finned pilot whale	Jobos Bay and Offshore		
Spinner dolphin	Offshore		
Striped dolphin	Offshore		

Source: NMFS, 2013b

[a] Offshore refers to the area south of Jobos Bay (beyond the barrier islands).

Whales

Whales are long-lived marine mammals that inhabit the world's oceans. Many species migrate extremely long distances to take advantage of seasonal food resources or calm wintering grounds for rearing young. They can be divided into two main groups: toothed whales and baleen whales. Feeding morphology and prey are the major differences between these groups. Whales commonly use warm tropical waters during winter months when the polar seas are cold, ice covered, and food-poor.

The three beaked whale species (Blainville's, Cuvier's, and Gervais) may occur in the Caribbean region and are found in deep offshore waters of the continental shelf and slope where they utilize deep diving to hunt for prey. These species of beaked whales feed on squid, octopus, fish, and crustaceans. The Blainville's and Cuvier's beaked whales' range of distribution extends worldwide while the Gervais beaked whale is limited to the central and north Atlantic. The Blainville's and Cuvier's whales commonly associate with steep underwater geologic structures. As of 1986, there have been eight documented sightings of Cuvier's beaked whales off Puerto Rico and the Virgin Islands (Mignucci-Giannoni, 1998). Mignucci-Giannoni's studies concluded that although Blainville's and Gervais beaked whales have not been recorded off Puerto Rico or the Virgin Islands since 1989, they may be present in the area. It is very unlikely these beaked whale species are present in the Project area due to the common depth range of this species. However, these species may be encountered along LNG carrier transit routes.

Bryde's whales are baleen whales found in tropical and subtropical temperate waters near the continental shelf. Smaller species may prefer to reside in coastal zones (NMFS, 2013b). Bryde's whales feed on plankton, crustaceans, and schooling fish. Bryde's whales are known to be present in the southeastern Caribbean; however, in studies conducted by Mignucci-Giannoni (1998), there were no documented sightings of Bryde's whales off Puerto Rico. It is very unlikely Bryde's whales are present in the Project area due to the common depth range of this species. However, Bryde's whales may be encountered along LNG carrier transit routes.

Dwarf sperm whales and pygmy sperm whales are similar in appearance and share a similar geographic range. Both species are distributed worldwide in tropical to temperate waters. Dwarf sperm whales inhabit the continental shelf edge and slope while pygmy sperm whales are usually found seaward of this area. Both species feed on squid, octopus, crabs, shrimp, and fish. The dwarf sperm whale is generally considered more of a coastal species than the pygmy sperm whale (NMFS, 2013b). Five pygmy sperm whale strandings were documented within Puerto Rico and the Virgin Islands between 1976 and 1989. While the dwarf sperm whale has not been documented within this area during this timeframe, it may be present (Mignucci-Giannoni, 1998). Both species are generally considered rare as there is limited information available (NMFS, 2013b). It is very unlikely dwarf and pygmy sperm whales are present in the Project area due to the common depth range of these species. However, these species may be encountered along LNG carrier transit routes.

Minke whales are baleen whales that prefer temperate to colder northern waters, but are also found in tropical and subtropical areas and can be found in both coastal and oceanic waters. Minke whales feed on crustaceans, plankton, and schooling fish (NMFS, 2013b). Minke whales have been observed in Puerto Rican waters on three occasions documented in 1965, 1973, and 1976 (Mignucci-Giannoni, 1998). It is possible, yet unlikely that minke whales are present in the Project area and LNG carrier transit routes due to their preferred geographic range.

Dolphins

Atlantic spotted dolphins are found within warm tropical to temperate waters of the Atlantic Ocean. Their diet consists of small fish, squid, octopus, and benthic invertebrates. Eighty-five percent of Atlantic spotted dolphin sightings in Puerto Rico or the Virgin Islands have been within the shelf in areas of low seafloor relief (Mignucci-Giannoni, 1998). The presence of Atlantic spotted dolphins within the Project area is possible due to their occasional association with bottlenose dolphins (NMFS, 2013b), which are present in the Project area, and their presence being noted off the south coast of Puerto Rico by MacKay (2014). Additionally, Atlantic spotted dolphins may be encountered along LNG carrier transit routes.

Bottlenose dolphins are found in tropical and temperate waters worldwide. Coastal populations commonly migrate into bays and estuaries while offshore populations reside along the continental shelf. The coastal populations feed on fish and benthic invertebrates. Bottlenose dolphins were documented during surveys conducted by Aguirre LLC within the Project area. Additionally, they may be encountered along LNG carrier transit routes.

Clymene dolphins inhabit tropical, subtropical, and warm temperate waters in the Atlantic Ocean. This species is generally found in oceanic waters ranging from 820 feet to 16,400 feet in depth and feeds on small deep sea fish and squid (NMFS, 2013b). Clymene dolphins have been observed in some areas of the Caribbean, but not in Puerto Rico as of 1989 (Mignucci-Giannoni, 1998). It is very unlikely

Clymene dolphins are present in the Project area due to the common depth range of this species. However, clymene dolphins may be encountered along LNG carrier transit routes.

Fraser’s dolphins prefer warm tropical to temperate oceanic waters, usually deeper than 3,000 feet (914 m). They feed on deep sea species of fish, shrimp, squid, and octopus (NMFS, 2013b). Frasier’s dolphins have been observed in other areas of the Caribbean, but as of 1989, not in Puerto Rico (Mignucci-Giannoni, 1998). It is very unlikely Fraser’s dolphins are present in the Project area due to the common depth range of this species. However, Fraser’s dolphins may be encountered along LNG carrier transit routes.

Melon-headed whales are members of the dolphin group that are found in deep tropical waters worldwide. Melon-headed dolphins have been observed in other areas of the Caribbean, but as of 1989, not in Puerto Rico (Mignucci-Giannoni, 1998). It is very unlikely melon-headed dolphins are present in the Project area due to the common depth range of this species. However, melon-headed dolphins may be encountered along LNG carrier transit routes.

Orcas are found in all parts of the world’s oceans and have the most wide geographic distribution of all marine mammals. They are most commonly found in water depths of 200 to 260 feet (20 to 60 m) (Burnett, 2009). Their diet varies depending on the specific population or location, but can include fish, other marine mammals, and sharks (NMFS, 2013b). Thirteen sightings of orcas were reported off of Puerto Rico and the Virgin Islands between 1979 and 1989; however, the closest sighting to the Project area was off Cabo Rojo on the southwest coast of Puerto Rico (Mignucci-Giannoni, 1998). MacKay (2014) noted their presence off the south coast of Puerto Rico. It is unlikely yet possible that orcas are present in the Project area due to the common depth range of this species. Additionally, orcas may be encountered along LNG carrier transit routes.

Pantropical spotted dolphins inhabit tropical and subtropical waters worldwide, in water depths ranging between 300 and 1,000 feet (91 and 305 m) during the day. Pantropical spotted dolphins have been observed in other areas of the Caribbean, but as of 1989, not in Puerto Rico (Mignucci-Giannoni, 1998). It is very unlikely pantropical spotted dolphins are present in the Project area due to the common depth range of this species. However, pantropical spotted dolphins may be encountered along LNG carrier transit routes.

Risso’s dolphins are found in tropical to temperate waters worldwide in water depths deeper than 3,300 feet (1,006 m) seaward of the continental shelf and slope. A 1998 study indicates that Risso’s dolphins have not been observed off the coast of Puerto Rico but have been observed in the Caribbean in areas of very deep water east of Puerto Rico (Mignucci-Giannoni, 1998). MacKay (2014) noted their presence off the south coast of Puerto Rico. It is unlikely yet possible that Risso’s dolphins are present in the Project area due to the common depth range of this species. Additionally, Risso’s dolphins may be encountered along LNG carrier transit routes.

Rough toothed dolphins reside in tropical and warmer temperate waters worldwide and prefer deep water where their food source is abundant. Mignucci-Giannoni (1998) reports nine sightings in the Caribbean off of Puerto Rico and the Virgin Islands. The closest sighting to the Project area was within the continental shelf off of Fajardo, Puerto Rico, approximately 50 miles (80 km) northeast of the Project area (Mignucci-Giannoni, 1998). It is very unlikely rough toothed dolphins are present in the Project area due to the common depth range of this species. However, rough toothed dolphins may be encountered along LNG carrier transit routes.

Pygmy killer whales are members of the dolphin family found in tropical and subtropical deep waters worldwide. Pygmy killer whales have been observed in other areas of the Caribbean, but as of 1989, not in Puerto Rico (Mignucci-Giannoni, 1998). It is unlikely Pygmy killer whales are present in the

Project area due to their preference for deep waters. However, pygmy killer whales may be encountered along LNG carrier transit routes.

Short-finned pilot whales are members of the dolphin group found worldwide in tropical and subtropical areas. Short-finned pilot whales typically prefer deeper waters to feed but are also found in shallower coastal water. Although their primary food source consists of squid, they may also feed on octopus and fish (NMFS, 2013b). Short-finned pilot whales have been documented near the Project area in offshore waters south of Salinas, Puerto Rico (Mignucci-Giannoni, 1998). MacKay (2014) noted their presence off the south coast of Puerto Rico. Short-finned pilot whales may occur in the Project area and along LNG carrier transit routes.

Spinner dolphins reside in tropical and subtropical waters worldwide. They are found in deep ocean waters where their prey is concentrated. The closest sighting to the Project area was within the continental shelf off of Fajardo, Puerto Rico, approximately 50 miles (80 km) northeast of the Project area (Mignucci-Giannoni, 1998). MacKay (2014) noted their presence off the south coast of Puerto Rico. It is unlikely yet possible that spinner dolphins are present in the Project area due to their preference for deeper waters. Additionally, spinner dolphins may be encountered along LNG carrier transit routes.

Striped dolphins are found in tropical to warm temperate waters worldwide. They mainly reside in deep oceanic waters seaward of the continental shelf. Striped dolphin sightings have been reported along the southern coast of the Caribbean Sea, but not in Puerto Rico or nearby islands (Mignucci-Giannoni, 1998). MacKay (2014) noted their presence off the south coast of Puerto Rico. It is unlikely yet possible that striped dolphins are present in the Project area due to their preference for deeper waters. Additionally, striped dolphins may be encountered along LNG carrier transit routes.

4.5.3.2 Birds

Puerto Rico supports a rich and diverse range of bird species due to its variety of habitats and protected reserves. Threatened and endangered species are discussed further in section 4.6 of this EIS. Migratory birds are protected under the MBTA and Executive Order 13186. The executive order was enacted, in part, to ensure that environmental analyses of federal actions evaluate the impacts of actions and agency plans on migratory birds. It also states that emphasis should be placed on species of concern, priority habitats, and key risk factors, and it prohibits the take of any migratory bird without authorization from the FWS. The destruction or disturbance of a migratory bird nest that results in the loss of eggs or young is also a violation of the MBTA. The Project area, particularly the JBNERR, provides habitat for various migratory bird species that winter in the area.

Birds of Conservation Concern are a subset of birds protected under the MBTA and include all species, subspecies, and populations of migratory nongame birds that are likely to become candidates for listing under the ESA without additional conservation actions (FWS, 2008). The Project is within the Caribbean Islands Birds of Conservation Concern Region. Birds of Conservation Concern and other migratory birds potentially occurring in this region are listed in table 4.5.3-2.

4.5.3.3 General Impact and Mitigation

Construction of the Project would result in short-term, minor to moderate adverse impacts on marine wildlife species. The most common effects would likely be the general avoidance or isolation from preferred habitat due to construction activities. Noise impacts on marine mammals as a result of construction activities may also cause moderate adverse impacts. Operation of the Project would result in permanent, minor adverse impacts on marine wildlife species from increased vessel traffic and vessel strikes, habitat alteration/loss, thermal plume discharge, inadvertent hydrocarbon spills, noise, and lighting. Much of the impact discussion included below would also apply to marine wildlife species protected under the ESA that are described in detail in section 4.6.

TABLE 4.5.3-2

Migratory Bird Species Potentially Occurring in the Aguirre Offshore GasPort Project Area

	Habitat Type				
Common Name	Seagrass and Macroalgae [a]	Mangrove	Mud Flat	Coral Reef [a]	Offshore
American oystercatcher [a]	X		X		
Audubon's shearwater [a]				X	X
Bananaquit		X			
Black-necked stilt	X		X		
Black-whispered vireo		X			
Brown booby [b]				X	X
Common sandpiper	X		X		
Flamingo [b]			X		
Glossy ibis	X		X		
Great blue heron	X	X	X		
Great egret	X	X	X		
Greater yellowlegs	X		X		
Least sandpiper	X		X		
Magnificent Frigatebird [b]				X	X
Masked booby [b]				X	X
Northern mockingbird		X			
Peregrine falcon		X	X		
Red-footed booby [b]				X	X
Red-tailed hawk		X			
Red knot [b]	X		X		
Royal tern				X	
Ruddy turnstone	X		X		
Sandwich tern				X	
Semipalmated plover	X		X		
Semipalmated sandpiper [b]	X		X		
Short-billed dowicher	X		X		
Snowy egret	X	X	X		
Snowy plover [b]	X		X		
Stilt sandpiper	X		X		
Turkey vulture		X			
White-crowned pigeon [b]		X			
Wilson's plover [b]	X		X		
Yellow warbler		X			

[a] Species may occupy this habitat type where located in shallow water (i.e., during low tides).
[b] Bird of Conservation Concern for Caribbean Islands.
Sources: Field et al., 2003; FWS, 2008

Increased Vessel Traffic and Vessel Strikes

Construction activities, associated with the proposed action, would result in increased vessel traffic in Jobos Bay and the offshore project area. Vessel traffic during construction would consist of approximately six to eight construction and support vessels working within and/or traveling to and from the construction sites.

Pipeline construction would involve various vessels with specialized construction capabilities, as well as other vessels to support construction activity. These support vessels would include a crew/supply boat, survey vessel, derrick barge, pipe lay spud barge, assist tugs, crane barge, and shallow-draft pipe haul barges. Construction of the subsea pipeline would take place over a period of approximately 3 months for a number of marine vessels supporting construction. The pipeline would be installed in two stages. The first stage would consist of laying the pipe on the sea bottom. The second stage involves specific lowering procedures to meet the burial requirements in accordance with DOT regulations (49 CFR 192). Completion of the pipeline includes several other tasks, such as conducting hydrostatic testing of the pipeline and performing an as-built survey.

For construction of the offshore berthing platform, Aguirre LLC would pursue the use of prefabricated modular designs to reduce the need for onsite complex formwork operations over water. Advantages include a reduced construction schedule and smaller crews and associated marine support. Construction of the offshore platform would take place over a period of approximately 12 months, and is estimated to include 200 days of operation for a derrick barge and an assist tug.

During Project operations, LNG carriers, ranging in length from 880 to 1,045 feet, are assumed to make 50 deliveries per year (one every 8 days) with a 3-day stay per calling event. Four support tugboats would operate during arrival and departure of each LNG carrier to assist with mooring and unmooring from the terminal platform. It is anticipated that each tugboat would spend 4 hours in transit and 4 hours in mooring/unmooring per LNG delivery. A supply vessel would transport personnel to and from the offshore platform and would assist with routine operations and the delivery of supplies.

Estimated weekly vessel traffic within and south of Jobos Bay has been summarized in section 4.7.1. The most frequent vessel traffic in the study area was recreational vessels. The study found that during a typical week there are approximately 50 to 75 recreational vessels within Jobos Bay and 75 to 100 recreational vessels south of Jobos Bay. The least amount of vessel traffic on a weekly basis is LNG carriers to the EcoEléctrica LNG Facility and vessels to AES Coal. South of Jobos Bay, there are approximately one to two LNG carriers to EcoEléctrica and approximately one vessel that goes to AES Coal per week. There is a moderate amount of weekly commercial fishing vessels, including 35 to 45 vessels within Jobos Bay and 40 to 50 vessels south of Jobos Bay. Ocean-going vessel traffic within Jobos Bay includes 3 to 4 vessels, and south of Jobos Bay includes 8 to 10 vessels. Lastly, it is estimated that one to five diving vessels use Jobos Bay on a weekly basis.

Vessel traffic can affect marine mammals by direct collisions, ship noise (which may cause behavioral disturbance), wave action from boat wakes, and accidental hydrocarbon spills. Potential impacts from noise on marine mammals from vessel traffic are discussed below. Potential impacts for the inadvertent discharge of petroleum hydrocarbons related to increased vessel traffic are discussed in section 4.5.2.4 and below. The Antillean manatee and humpback whale are federally listed species and are discussed in detail in section 4.6.1.

Injuries and deaths resulting from direct ship collisions represent a significant threat to several large whale populations (Laist et al. 2001; Jensen and Silber, 2003). All types and sizes of vessels hit whales, but most lethal and serious injuries are caused by larger vessels (Laist et al., 2001). Data from around the world (including the U.S. Atlantic Coast, Gulf of Mexico, and Puerto Rico) were compiled and analyzed to better understand the nature and extent of collisions between motorized collisions and large whales:

1. historical collision records before 1951;
2. recent whale stranding records;
3. anecdotal accounts from vessels involved in collisions; and
4. data on number and speeds of ships (Jensen and Silber 2003; Laist et al., 2001).

Laist et al. (2001) reports that of 15 whales considered severely injured by ship strikes, 3 were struck by vessels less than 65.5 feet (20 m) long, 3 were struck by vessels 65.6 to 262.5 feet (20 to 80 m) long, and 9 were struck by vessels longer than 262.5 feet (80 m) long. Of 23 whales killed by vessel strikes, at least 30 whales (87 percent) were struck by vessels more than 262.5 feet (80 m) long (Laist et al., 2001). Of the 58 collision accounts reported with large whales, 53 occurred on the continental shelf or shelf slope (Laist et al., 2001). The insular shelf (defined as the shelf surrounding an island) south of Jobos Bay, at the Offshore Gasport, is relatively wide as compared to other areas along the Puerto Rico coastline and is relatively flat, typical of inclination slopes along the Puerto Rico south coast (Tetra Tech, 2013b).

Vessel speed is a principal factor in the severity of injury or likelihood of mortality among whales struck by ships (Jensen and Silber, 2003). Vessel speed at the time of strike was reported in 58 of the 292 strikes recorded in NOAA's Large Whale Ship Strike Database (Jensen and Silber, 2003). The range of speeds at which vessels were operating when a whale was hit was 2 to 51 knots, with a mean speed of 18.1 knots (Jensen and Silber, 2003). Laist et al. (2001) reported that no vessel collisions resulting in lethal or severe injuries to whales were reported at speeds below 10 knots. The mean vessel speed which resulted in injury or mortality to a whale was 18.6 knots. LNG carriers, which have a maximum transiting speed of 19 knots in the open ocean, could result in mortality to a whale if struck, because their transiting speed is greater than 10 knots (Tetra Tech, 2013b). However, LNG carriers push a considerable bow wave when underway on the open ocean because of their design and large displacement tonnage. This wave pushes water, flotsam, and other small objects (such as dolphins) away from the vessel.

Although possible, ship strike impacts on whales within Jobos Bay are unlikely during construction because vessels approaching or operating in nearshore waters generally transit at much slower speeds than in open water, and whales are less likely to occur in nearshore waters. Ship strike impacts on whales during construction activities in the offshore Project area could potentially occur if proper mitigation measures are not implemented. Dolphin species could experience propeller or collision injuries due to the increase in vessel traffic related to construction activities within Jobos Bay and the offshore areas. However, operation of the Project would result in a 90 percent decrease in barge traffic within Jobos Bay, decreasing the current risk of vessel strikes on dolphin species and on whale species if they occur within the bay.

Increased vessel traffic from construction and operation of the Project could potentially interrupt mother whales with neonates if they travel near the Project area. The increase in construction-related vessel traffic in the offshore Project area could change whale migration routes or disrupt nursing events. This disruption could increase the risk of their mortality by placing them in areas where they are more vulnerable to predators or by reducing their conserved energy reserves (Office of National Marine Sanctuaries, 2010; Reeves, 1992).

During Project operations, vulnerability to collision with an LNG carrier, or the associated assist tugs, would be greatest while marine mammals feed, swim, and rest near the surface of the water. In areas of heavy ship traffic, whales and dolphins can experience propeller or collision injuries; however, most of these injuries are caused by fast moving vessels. LNG carriers operating within the U.S. Exclusive Economic Zone (EEZ) are generally slower and generate more noise than typical large vessels and would be more readily avoided by mammals. The maximum transiting speed of an LNG carrier and FSRU is approximately 19 knots; however, when transiting to and from the ports and sensitive areas vessel speeds are restricted. At closer distances of under 2 miles (3.2 km), vessel speeds would be reduced to close to 3 knots (3.5 mph) or less than 1 knot at a distance of about 0.5 mile (Tetra Tech, 2013b).

To minimize the potential for vessel strikes during construction and operation, vessel operators and crews would receive training in protected species identification and would keep watch for marine mammals and sea turtles. The DNER has expressed interest in participating in the development and execution of this training. Aguirre LLC would contract firms with experienced biologists who are specially trained and certified in marine mammal observation. Certified marine mammal observers (MMOs) would be assigned to construction vessels during all construction phases of the Project. Their exclusive responsibility would be to watch for marine mammals and sea turtles and to alert the construction crew supervisor if marine mammals or sea turtles are visually detected within the zone, generally within 1,600 feet (488 m) of the vessel, to allow for mitigating responses.

Whenever an observation of a marine mammal or sea turtle is made, the vessel's MMO would radio call the lead MMO. The lead MMO would disseminate the information to the other vessel MMOs working at the time. The general response to a manatee sighting is to maintain a distance of at least 50 yards (46 m) for one individual and to reduce vessel speed to 10 knots (18.5 kilometers per hour) or less and maintain a minimum distance of 100 yards (91 m) when mother/calf pairs, groups, or large assemblages of cetaceans are observed near an underway vessel, when safety permits. It should be noted that Puerto Rico regulation requires marine vessels to maintain a 109 yards (100 meters) for humpback whales; an amendment to the regulations has been proposed to include all marine mammals under these guidelines. MMOs would have stop work authority and would maintain *in situ* records while on watch. The shore-based MMO coordinator would also be assigned to collect remote data and collate all sighting data on a daily basis and submit daily, weekly, or monthly reports to agencies as requested.

Observing would take place at all hours of the day that viewing conditions are acceptable (visibility at least 500 feet [152 m] and Beaufort sea states [11] less than five). Nighttime observations would be conducted with the aid of a night-vision scope where practical. Observers, using binoculars, would estimate distances to marine mammals either visually or by using reticle binoculars. If higher vantage points (greater than 25 feet [8 m]) are available, distances can be measured using inclinometers. Position data would be recorded using hand-held or vessel GPS units for each sighting, vessel position change, and any environmental change.

Environmental data would be collected at the time of each observation, including sea state, wind speed, wind direction, ambient temperature, precipitation, glare, and percent cloud cover. Wind and temperature data would be extracted from onboard meteorological stations (when available). Animal data to be collected include number, species, position, distance, behavior, direction of movement, and apparent reaction to construction activity. The MMOs would keep notes of activities and prepare and submit a daily report on a daily, weekly, or monthly basis, as requested by the applicable agencies (e.g., the NMFS and FWS). To further ensure impacts on marine mammals and sea turtles during construction and operation of the Project are minimized or avoided, **we recommend that**:

- **<u>Prior to construction,</u> Aguirre LLC should coordinate with the FWS, NMFS, and DNER to develop a detailed MMO training and response protocol plan for the construction and operation phases of the Project. The plan should provide appropriate measures to avoid and minimize potential vessel strikes of manatees and sea turtles and incorporate the FWS's manatee conservation measures for in-water work, where applicable. In addition, Aguirre LLC should restrict the transit of crew boats during construction and operation to daytime trips to allow for the observation of marine mammals and decrease the potential for vessel strikes. The plan should also require that travel speeds for Project construction-related vessels be reduced to no-wake (5 mph [4.3 knots]) levels, especially in waters shallower than 10 feet. In addition to the MMO plan, Aguirre LLC should use aerial surveys to**

[11] The Beaufort scale is an empirical measurement of sea or land conditions relating to wind speed and observed conditions. The sea state scale ranges from 0 to 12, with 0 being calm and 12 being hurricane conditions. A sea state of five is called a "Fresh Breeze," where winds range from 17 to 21 knots (31 to 39 kilometers per hour); waves are 6 feet (1.8 m) with white caps and the chance of spray (NOAA, undated).

identify and assess impacts on the behavior of marine mammals and sea turtle proximate to the construction work areas.

With these measures in place, the impact of vessel traffic and vessel strikes on marine mammals is anticipated to be short-term and negligible during construction, and permanent but minor during Project operation. If a non-ESA-listed marine mammal may be adversely affected by the proposed action, a take authorization under the MMPA may be necessary. If the take authorization were to involve a manatee, the FWS would issue the authorization. The NMFS would review take authorizations for the remaining species if requested.

Noise

Marine mammals rely heavily on the use of underwater sounds to communicate and gain information about their environment. Cetaceans, in particular, are heavily dependent on sound for food-finding, communication, reproduction, detection of predators, and navigation (Weilgart, 2007). Even without man-made sounds, the sea is noisy, and ambient background noise can interfere with the ability of marine mammals to detect sound signals even when signals are above the species' absolute hearing threshold. Ambient background noise includes natural contributions from wind, waves, precipitation, other animals, and from distant human activities such as shipping or oil exploration and production. Ambient noise is highly variable over continental shelves, and this inevitably results in a higher degree of variability in the range at which marine mammals can detect man-made sounds.

The noise levels reported in this section may appear higher than those commonly noted for construction because the reference value for underwater sound pressure is 1 microPascal, whereas in-air sound uses a reference of 20 microPascals. The discrepancy relates to differences in the acoustic impedance, density, and compressibility of air and water. For example, the threshold of hearing for humans is 0 dB in the air, but 60 dB in water. Similarly, direct tissue damage to humans can occur at 160 dB in the air, but rises to 222 dB in water (Tetra Tech, Inc. [Tetra Tech], 2013c).

Noise from general construction and pile driving activities would be generated at the Offshore GasPort and within Jobos Bay, as well as from general construction of the subsea pipeline. Background noise levels were measured by Aguirre LLC during the hydroacoustic survey and found to be around 120 dB at the Offshore GasPort site and closer to 140 dB within Jobos Bay.

Vibratory hammers would be primarily used for pile installation, with impact hammers used only as needed for final seating of piles. Once construction of the Project has been completed, the temporary piles would be removed by the same method with a vibratory hammer. Impact pile driving typically generates much higher sound levels than vibratory pile driving. Vibratory pile drivers install pilings into the ground by applying a rapidly alternating force to the pile and are powered by hydraulic pumps. Impact piling is performed using hammers which drive the pile by first inducing downward velocity in a metal ram. Rather than begin impact pile driving at full force, hammer strength would gradually be ramped up to provide a warning mechanism to marine life in the area.

Temporary piles are proposed at the offshore area along the pipeline route to secure the pipelay barges used to implement the pipe lay technique. Nine structural jackets and four tri/quad pile structures would be installed at the Offshore GasPort. At the terminal (PI 1) the largest 80-inch-diameter (2 m) pile would be installed with an impact hammer applying a 600-kilojoule (kJ) maximum strike force. The temporary piles needed for pipeline construction would have smaller 24-inch-diameter (0.6 m) piles and would be installed with an estimated 150 kJ maximum strike force. Aguirre LLC conducted both in-air and underwater acoustic modeling calculations to assess noise levels associated with pile driving along the proposed pipeline, and to assess noise levels associated with general construction equipment and operation of the facility.

NMFS recognizes three kinds of noises that could be potentially harassing to marine mammals: continuous, intermittent, and pulse. NMFS defines two levels of harassment due to noise levels under the MMPA: Level A (180 dB) and Level B (160 dB intermittent, 120 dB continuous). These harassment levels are defined as:

- Level A – harassment that has the potential to injure a marine mammal; and
- Level B – harassment that has the potential to disturb a marine mammal by causing disruption of behavioral patterns, such as migration, breathing, nursing, breeding, feeding, or sheltering.

The underwater noise generated by pile-driving strike depends primarily on the following factors:

- the impact energy and type of pile driving hammer;
- size and type of pile;
- water depth; and
- subsurface hardness in which the pile is being driven.

Acoustic modeling was completed with the widely used Range Dependent Acoustic Model which is based on the U.S. Navy's Standard Split-Step Fourier Parabolic Equation. Because the seafloor and its properties are variable based on location, it is necessary to use a range dependent model that is programmed to account for these variations along the propagation path.

The hydroacoustic modeling of noise attenuation indicates that the estimated noise associated with construction activities, not including pile driving activities, and support vessels would not exceed the Level A harassment threshold, but would exceed Level B harassment levels within 33 feet (10 m) of the source for the 160-dB limit, within 2.1 to 2.2 miles (3.4 to 3.5 km) for the 120-dB limit in the Offshore GasPort area, and within 0.4 to 1.4 miles (0.5 to 2.3 km) for the 120-dB limit within Jobos Bay. The hydroacoustic modeling of noise attenuation indicates that vibratory pile driving would exceed the 180 dB threshold within 33 feet (10 m) of the source of the sound and exceed the 160 dB threshold within 213 to 738 feet (65 to 225 m) depending on the location of the pile.

Underwater sound source level for impact pile driving the larger 80-inch-diameter pile (PI 1) is estimated to be 228 dB. The sound source level for installation of the smaller 24-inch-diameter pile is estimated to be 222 dB. Aguirre LLC did not provide a threshold distance from the sound source when evaluating underwater sound levels using impact hammering methods. Due to recent changes in the construction methods since the issuance of the draft EIS, Aguirre LLC is working with its contractors to use spud-leg barges to anchor and lay the pipe. However, we determined that, because the construction plan is not finalized, analyzing the impact of piles for impact on noise was appropriate. Both of the underwater sound levels associated with impact hammering of the piles exceed harassment levels under the MMPA. The 120 dB harassment level would not be applicable for pile driving activities because it is not continuous noise.

Aguirre LLC conducted modeling to determine the anticipated net reduction in noise with the implementation of bubble curtain technology during impact pile driving. Table 4.5.3-3 summarizes the distances to the critical MMPA Level A Harassment threshold of 180 dB using impact pile driving techniques both with and without bubble curtain technology. Noise levels of 180 dB associated with impact pile driving would be exceeded within 65 feet (20 m) with the use of bubble curtain technology for both the 80-inch and 24-inch piles. A similar net reduction in noise levels would be expected with the use of bubble curtain technology during vibratory pile driving events. However, the effectiveness of bubble curtains varies from site to site, and can vary with the frequency spectrum of the impact hammer. Furthermore, the use of bubble curtains can be challenging in areas with deep channels or subject to strong currents.

TABLE 4.5.3-3

Underwater Acoustic Modeling Results Summarizing Distance to MMPA Level A Harassment Threshold During Impact Pile Driving With and Without Bubble Curtain Mitigation

Location	Description	Distance to 180 dB Threshold (meters)	Distance to 180 dB Threshold with Bubble Curtain Mitigation (meters)
Terminal facilities (PI 1)	Impact pile driving of 80" pile with 600 kJ of strike force	1,815	< 20
Pipeline (PI 2)	Impact pile driving a 24" pile with 150 kJ of strike force	275	< 20
Pipeline (PI 3)	Impact pile driving a 24" pile with 150 kJ of strike force	515	< 20
Pipeline (PI 4)	Impact pile driving a 24" pile with 150 kJ of strike force	500	< 20
Power Plant Dock (PI 5 and PI 6)	Impact pile driving a 24" pile with 150 kJ of strike force	180	< 20

Noise from incoming vessels and the Offshore GasPort operations would be generated within the immediate vicinity of the shipping route and platform location. Background noise levels were measured by Aguirre LLC during the hydroacoustic survey and found to be about 120 dB at the Offshore GasPort site. The modeled sound levels from LNG carriers are expected to be 160 to 170 dB on their transit in and out of the Offshore Gasport. Thrusters could be utilized upon the approach and berthing; this is anticipated to be of short duration (less than 30 minutes) and would raise the ambient noise levels to 183 dB. The use of thrusters for LNG and FSRU vessels may be minimized by the use of support tugs. There would be no thruster-enabled vessels in use within Jobos Bay. The hydroacoustic modeling of noise attenuation completed by Aguirre LLC indicates that transiting LNG carrier noise would exceed the 120-dB limit within 1.0 to 1.1 miles (1.6 to 1.8 km) of the source of the sound, depending on the transiting direction of the LNG carrier. If thrusters are used, the sound generated is predicted to exceed the 160-dB limit within 164 feet (50 m) of the source. The 120-dB harassment level would not be applicable for thrusters because it is not continuous noise.

Known effects of noise on marine mammals have been reviewed by various sources (National Research Council, 2003; Southall et al. 2007; Weilgart, 2007). Human-made sounds can affect the ability of marine mammals to communicate and to receive information about their environment. Such noise can interfere with or mask the sounds used and produced by these animals and thereby interfere with their natural behavior. Observed effects of noise on marine mammals include changes in vocalizations; respiration, swim speed, diving, and foraging behavior; increased alertness; temporary or permanent displacement; avoidance; shifts in migration path; stress; hearing damage; panic; and strandings (NRC, 2003; Southall et al., 2007; Weilgart, 2007). Noise exposure may affect the vestibular and neurosensory systems of marine mammals (primarily pinnipeds) and potentially respiratory patterns (Southall et al., 2007). Marine mammal responses to noise vary widely depending on the species, the context and duration of exposure, the types of noise sources, the time of day or year, the reproductive state of the animal, the activity of the animal at the time of exposure, and the experience or prior exposure of the animal (NRC, 2003; Southall et al., 2007). Minor or temporary behavioral effects are often evidence that an animal has heard a sound and may not indicate lasting consequence for exposed individuals (Southall et al., 2007). Determining if short-term changes in behavior represent a biologically significant effect is difficult. Immediate or short-term changes in behavior could represent short- or long-term effects on a population. Long-term impacts of greatest concern include reduced health and viability of a population.

Male humpback whales and mothers with neonates can be found in the Caribbean, including the southern coast of Puerto Rico, during the winter. The male humpbacks may attempt to find potential mates through vocalizations. Increased vessel traffic in the offshore area related to construction activities as well as LNG traffic during Project operation could disrupt vocalizations associated with breeding behavior of whales; whales are known to change their behavior in response to anthropogenic noise, including ship traffic (Office of National Marine Sanctuaries, 2010; Reeves, 1992).

Short-term, minor, direct, adverse impacts on marine wildlife could occur as a result of noise generated by construction vessels and machinery. To minimize noise impacts on marine wildlife species during construction, Aguirre LLC would employ qualified onsite MMOs for each construction vessel and barge to monitor a 0.3-mile (0.5 km) safety exclusion zone for marine mammals and sea turtles during all phases of construction. If a marine mammal or sea turtle is observed within the exclusion zone, construction activities, including pile driving, would be suspended until the animal moves out of the area. Contractors would be requested to 'ramp-up', which entails the gradual increase in intensity of a sound source and is a commonly practiced mitigation measure used during pile driving activities. The intent of ramp-up is to either avoid or reduce the potential for instantaneous hearing damage to an animal in close proximity. Increasing sound levels are designed to warn animals of pending operations, and to allow sufficient time for those animals to leave the immediate area. Dolphins may be deterred from entering Jobos Bay due to construction activities; however, this is expected to be a short-term minor impact because there are other feeding areas available along the southern coast of Puerto Rico. Noise impacts on marine mammals during operation of the Project are expected to be permanent but minor. These animals are highly mobile and could avoid areas of noise that would cause them discomfort or harm; however, we recognize use of some habitats could be lost due to noise impacts. In order to properly conduct noise mitigation measures during construction to reduce impacts on marine mammals and sea turtles near the project area **we recommend that:**

- **<u>Prior to construction</u>, Aguirre LLC should verify that it would use confined bubble curtains when conducting vibratory and hammer pile activities in order to reduce impacts on marine wildlife species during construction of the Project. Aguirre LLC should develop a detailed noise mitigation protocol for the safety exclusion zone (0.3 mile [0.5 km]) that identifies when the noise mitigation protocol would be implemented during construction and explains how each MMO would identify the limits of the exclusion zone. The protocol should include the measures outlined in the FWS's draft EIS comment letter dated October 20, 2014.**

With these measures in place, we conclude noise impacts on dolphins and whales in the offshore environment would be minor. These animals are highly mobile and would avoid areas of noise that cause them discomfort or potential harm.

Bird species in or adjacent to the Project area may experience short-term moderate impacts as they may be temporarily displaced from areas with elevated noise levels. The level of impact would vary depending on the bird species, type of vessel or machinery, vessel speed, relative noise level, distance, frequency, and season. During Project installation, increased noise levels could temporarily displace coastal and marine birds from commonly used feeding or resting areas, but displaced birds would be expected to return shortly after construction ceased. Noise impacts on birds during operation of the Project are expected to be permanent but minor. These animals are highly mobile and could avoid areas of noise that would cause them discomfort or harm. To ensure that construction-related and operational noise impacts on birds are minimized or avoided, **we recommend that:**

- **<u>Prior to construction</u>, Aguirre LLC should file with the Secretary an assessment of potential noise impacts on resting and nesting birds during construction (e.g., pile driving, vessels, and possible HDD) and operation of the Project, and identify mitigation measures that Aguirre LLC would implement to minimize or avoid these impacts.**

Inadvertent Hydrocarbon Spills

General impact and mitigation information regarding inadvertent hydrocarbon spills are described in section 4.5.2.4. Minor releases of hydrocarbons during construction could result in short-term, minor to moderate adverse impacts on marine wildlife species. Accidental releases of hydrocarbons resulting from operation of the Project are expected to have short-term and minor to moderate impacts on marine wildlife resources. To ensure that inadvertent hydrocarbon spill impacts on federally listed species and migratory birds are minimized or avoided, **we recommend that:**

- **<u>Prior to construction,</u> Aguirre LLC should file with the Secretary, as part of its site-specific Spill Prevention and Control Plan, response measures that would be implemented if wildlife, including federally listed species or migratory birds, are impacted by an inadvertent hydrocarbon spill.**

Habitat Alteration/Loss

Overall habitat modification impact information and acreages for benthic resources (e.g., seagrasses, corals, and macroalgae) used by marine wildlife are discussed in section 4.5.2.4. Marine mammals and birds in the offshore portion of the Project area would likely move away from areas of disturbance to other similar, adjacent habitats. Within Jobos Bay, destruction of seagrasses, macroalgae, and coral reef would result in a loss of feeding habitat for various migratory bird and dolphin species, as well as the Antillean manatee population (see section 4.6.1.1) and sea turtles (see section 4.6.1). These construction impacts are expected to take place within a 20-foot-wide (6.1 m) corridor along the pipeline, where sediment displacement, resuspension, transport, and redeposition would impact benthic resources. Aguirre LLC has developed a coral reef and seagrass mitigation plan to compensate for impacts on these habitat types, see the draft Benthic Resources Mitigation Plan in appendix D. Additional recommendations for this plan have been provided in section 4.4.3. In addition, if use of the HDD is shown to be feasible, impacts on benthic habitat would be reduced. With mitigation measures in place, overall habitat impacts during construction are expected to be short-term and minor for most marine wildlife species.

Direct impacts on seagrass, coral reef, and macroalgae during operation of the pipeline could result in a permanent, minor loss of feeding habitat for several migratory bird, sea turtle, and marine mammal species. These operational impacts are expected to occur within an 8-foot-wide (2.4 m) corridor where concrete mats are placed along the above-grade pipeline in the Boca del Infierno pass (a total of 1,700 feet [518 m]) and where the mats are laid on the seafloor at the nearshore approach and at PI locations, as proposed by Aguirre LLC. However, based on our recommendations that would reduce or avoid impacts in this area, actual operational impacts would be less. With mitigation measures in place, and if the additional mitigation recommendations are implemented in section 4.4.3 above, the overall impacts of seagrass and macroalgal habitat loss on marine wildlife species resulting from operation of the Offshore GasPort are anticipated to be minor. The presence of the permanent structure in the offshore could be a beneficial effect for migratory birds, as it may provide roosting habitat as they travel and feed over the coastal waters.

Shading

General impacts from shading on benthic resources (e.g., corals and SAV) utilized by marine mammals are discussed in section 4.5.2.4. A temporary reduction in seagrass productivity due to shading could result in loss of feeding habitat for several migratory bird, sea turtle, and marine mammal species, including the large Antillean manatee population in Jobos Bay (see section 4.6.1.1). Aguirre LLC has developed a draft Benthic Resources Mitigation Plan (see appendix D) to compensate for impacts benthic resources. However, seagrass impacts due to shading from the Offshore Gasport have not been addressed in the draft plan. In section 4.4.3 above, we are recommending that prior to construction activities, Aguirre LLC submit additional mitigation plans for shading impacts on 2.9 acres (3.0 cuerdas) of seagrass from the Offshore GasPort. With mitigation measures in place, impacts on these species are expected to be permanent but minor. However, if permanent impacts on seagrasses due to shading from the Offshore GasPort are not addressed, these impacts have the potential to negatively impact various species that rely on seagrasses for food (i.e. Antillean manatee, sea turtles) or shelter (i.e. fish and benthic organisms).

Thermal Plume Discharge – Offshore Gasport

General impacts and mitigation information regarding thermal plume discharge from the Offshore GasPort are discussed in section 4.5.2.4. Impacts on marine wildlife species are expected to be minor, as marine mammals and sea turtles are mobile and would move out of the zone of heated water.

Anti-fouling Agents

Impacts of copper discharge associated with the MGPS on marine wildlife species are expected to be minor to insignificant. Marine mammals and sea turtles may pass through the outfall area near the copper discharge or they could consume organisms that bioaccumulate the cupric ions associated with the outfall area.

Lighting

The Project would necessitate the installation of temporary lighting to facilitate construction activities during evening hours as well as for safety requirements. Operation of the terminal would necessitate the installation of permanent lighting to meet operational safety and security requirements. To minimize lighting effects during operation, the Offshore GasPort would limit the number and wattage of operational lights to the minimum possible for safe operations. Light bulbs would be tinted or filtered, well shielded, and directed downwards toward the facilities so as to minimize illumination of surrounding waters.

The response of marine organisms to artificial lights can vary depending on a number of factors such as the species, life stage, and the intensity of the light. Small organisms are often attracted to lights, which in turn attracts larger predators to feed on the biological aggregations. Lights could cause artificially induced biological aggregations. Generally, impacts on marine wildlife species would be minor as these species may change their feeding habits based on these aggregations. To ensure that impacts associated with nighttime lighting during operation of the Project are minimized, **we recommend that:**

- **<u>Prior to construction,</u> Aguirre LLC should develop a lighting plan that identifies specific measures that would be implemented to minimize or avoid impacts associated with the Project's operational nighttime lighting on avian species, fish species, marine mammals, various life stages of sea turtles, and individuals on the shoreline. The plan should also analyze if the Project could artificially induce biological aggregations, and provide empirical evidence of how these potential aggregations could affect local fisheries and ecotourism. This plan should be filed with the Secretary for review and written approval by the Director of the OEP.**

4.5.4 Plankton

Plankton are small free-floating or weakly swimming organisms that are suspended in the water column. They have limited powers of locomotion and tend to drift with the prevailing water movements. Plankton communities are influenced by a variety of factors including food availability, grazing rates of predators, and coastal processes such as currents, tides, and storm events. Some plankton undergo vertical, diurnal migrations and are concentrated in deeper waters during the day and in shallower waters at night. The cumulative result of all of these variables leads to spatial and temporal patchiness. The plankton community also varies between the estuarine environment of Jobos Bay and the marine waters surrounding the Offshore GasPort site. In Jobos Bay, mangrove reefs restrict the flow of offshore water into the bay. This structure suggests a limited influence of planktonic marine species and a dominance of estuarine species within the bay, as opposed to a marine species-dominated community outside of the bay.

Plankton communities are made up of phytoplankton and zooplankton. Phytoplankton are tiny plants and microscopic algae that utilize available sunlight and nutrients to derive their energy. Zooplankton are small animals such as single-celled protozoans and the egg, larval, or adult forms of marine fish and invertebrates that feed on phytoplankton and other particulate matter. Zooplankton are further classified as either holoplankton or meroplankton. Holoplankton (e.g., copepods) spend their entire life as plankton, while meroplankton spend only a portion of their life cycles as plankton. Meroplankton includes both the egg and larval stages of invertebrates and fish (e.g., ichthyoplankton).

4.5.4.1 Phytoplankton

In the Project area, the phytoplankton community is dominated by diatoms and dinoflagellates (Field et al., 2003). In Jobos Bay, chlorophyll *a* concentrations have been observed to be significantly lower in the open water areas of the bay versus within the mangrove areas (Whitall et al., 2011). Concentrations were also significantly higher during the wet season, June to November (Whitall et al., 2011). This pattern is commonly found in estuaries and coastal locations around Puerto Rico (Gilbes et al., 1996; Otero and Carbery, 2005), as rainfall plays a large role in stormwater discharges from land and nutrient availability. In offshore and coastal waters, phytoplankton are vertically stratified and can be found in the waters where sunlight penetrates, which varies based on a number of factors including suspended particulate matter. Within Jobos Bay, a significant vertical stratification of phytoplankton is unlikely due to the shallow depths.

4.5.4.2 Zooplankton

Limited information is available about the holoplanktonic zooplankton community in the Project area. In similar ecosystems, this community is comprised mainly of copepods (Ríos-Jara, 2005). The meroplanktonic zooplankton is comprised of larval stages of fish, decapods, mollusks, and polychaetes (Ríos-Jara, 2005).

While data on the zooplankton community in the immediate vicinity of the Project area are limited, the 2003–2004 316 Demonstration Study by PREPA conducted within Jobos Bay found the dominant zooplankton species to be calanoid copepods (Washington Engineers PSC, 2005). This is similar to the holoplankton taxonomic assemblage dominated by the calanoid copepod, *Acartia tonsa*, found during baseline zooplankton surveys in Jobos Bay from 1972 to 1973. Other permanent components of the year-round resident zooplankton community in Jobos Bay, according to the 2003-2004 Demonstration Study, included chaetognath worms, larvaceans, sergestoid shrimps, and cyclopoid copepods. There was also a year-round prevalence of invertebrate larvae in the meroplankton, including such species groups as caridean shrimps, brachyuran and anomuran crabs, cirripeds (barnacles), polycheates, and gastropods (Washington Engineers PSC, 2005). This study, as well as previous reports for Jobos Bay and other coastal sites around Puerto Rico, demonstrated a seasonal pattern in total meroplankton abundances related to the dry season (e.g., significantly lower abundances between November to February [Washington Engineers PSC, 2005]). Echinoderm larvae in Puerto Rican estuaries have been shown to occur in highest numbers at the shelf break, versus either nearshore or further offshore (Williams and García-Sais, 2010). Conversely, the phyllosoma (larval) stage of spiny lobsters shows a trend of higher densities closer to shore (Sabater and García-Sais, 1998).

Overall, the combined zooplankton community is extremely diverse in form, function, and preferred habitat (García-Sais et al., 2008). The remainder of this discussion is focused on the egg and larval stages of fish (i.e., ichthyoplankton) and corals. Because of their regional importance, spiny lobsters (family Palinura) are included with the discussion of ichthyoplankton.

Ichthyoplankton

For the purposes of this assessment, the discussion of ichthyoplankton includes the early life stages of both finfish and spiny lobsters (family Palinura), including the egg and the larval stages up to the point where the individuals are large enough to swim against the currents. Coral larvae are discussed in the following section.

Survival for early life stages of finfish and shellfish is highly unpredictable and variable. Despite producing a large number of offspring, survival during these early stages has implications for the population on the whole (Houde, 1987). Factors important to survival during the early life stages include temperature, size, stage duration, food availability, and predation, with starvation and predation considered as the leading causes of larval mortality (Bailey and Houde, 1989).

The presence, abundance, and species composition of ichthyoplankton are influenced by a number of parameters, including spawning patterns, migrations, water currents, water temperature, salinity gradients, and larval behavior. Spawning in this region occurs year round as indicated by the presence of larval fish found throughout the year (Ramírez and García-Sias, 1997). Transport also plays a role in species composition of the plankton community. The currents near the proposed terminal site generally move east to west along the barrier cays and may bring different species into the region from other spawning locations to the east (Esteves-Amador, 2005). Tidal transport can also move estuarine species into the immediate offshore waters. A study off La Parguera in southwest Puerto Rico found an ichthyoplankton community with taxa representing both reef fish and oceanic species at the shelf-edge, with reef fish dominating numerically (Ramírez and García-Sias, 1997, Ramírez-Mella and García-Sais, 2003). Closer to shore the total larval abundance was higher, though fewer oceanic taxa were represented. The major families caught were Clupeiformes (pelagic spawning), Gobiidae (demersal spawning), and Myctophidae (oceanic taxa) (Ramírez-Mella and García-Sais, 2003). A similar dominance of nearshore species was observed in the Guayanilla and Tallaboa Bay region where stations were sampled inshore and offshore of coastal islands and at the 33-foot bathymetric contour (García et al., 1995).

The PREPA 2003–2004 316 Demonstration Study within Jobos Bay reported a bimonthly pattern of fish egg abundance, which suggests continuous reproduction of fishes that spawn planktonic eggs (Washington Engineers PSC, 2005). There was a relatively high abundance of fish eggs entrained possibly due to the in-situ production of resident shoreline fishes and the alongshore transport from nearby reef and seagrass habitat sources. The estuarine shoreline fishes that spawn round planktonic eggs within Jobos Bay include those in the families Sparidae (porgies), Sciaenidae (drums and croakers), Haemulidae (grunts), Carangidae (jacks), Callionymidae (dragonets) and Gerreidae (mojarras). During the 2003-2004 Demonstration Study, larval fish abundance in Jobos Bay was strongly represented by demersal fish types, such as Gobiidae, Tripterygiidae, and Callionymidae, which are families of fish that reproduce continuously in shallow habitats of the bay. Clupeiformes, which are pelagic spawners, were also numerically dominant in all sampling dates, thus indicating that they also reproduce continuously in Jobos Bay (Washington Engineers PSC, 2005). While the PREPA study was done within Jobos Bay, it provides insight to which species are found inshore of the Project area and could potentially be transported offshore via planktonic or pelagic ichthyoplankton stages.

A preliminary assessment of vertical variation on the ichthyoplankton community off La Parguera (Ramírez-Mella and García-Sais, 2004) indicated that oceanic species commonly increased in abundance below the surface waters (sampled at 0 to 66 feet [0 to 20 m] deep), including the Myctophidae (lanternfishes), Gonostomatidae (bristlemouths), and Photichthyidae (lighthouse fishes); whereas the

Clupeiformes (herring-like), Pomacentridae (damselfishes and clownfishes), Haemulidae (grunts), and Holocentridae (squirrelfishes) families were found in higher abundance. The Gobiidae (gobies) and Scaridae (parrotfishes) families, though reef fish, were also found in higher numbers deeper in the water column, and Lutjanidae (snappers) was commonly found in the midwater. This suggests that if the intake locations for the Project are located between 23 and 36 feet (7 to 11 m) as proposed, there would be a considerable overlap in space with where many larval fish and shellfish are found. Additionally, abundances in different depth zones change throughout the day as larvae come to the surface to feed at night and return to deeper depths during the day to avoid predation.

Aguirre LLC is currently developing, in discussion with the NMFS, FWS, DNER, and other appropriate agencies, a pre-operations ichthyoplankton baseline survey and monitoring plan. The plan would help analyze population distribution, abundance, and seasonal timing of ichthyoplankton in the Project area. Anticipated Project impacts on ichthyoplankton would be evaluated and discussed with applicable permitting agencies after the baseline study has been completed. Therefore, the site-specific data listed below have not been updated since the draft EIS.

Tetra Tech, on behalf of Aguirre LLC, conducted ichthyoplankton net sampling offshore of Boca del Infierno pass, near Guayama, approximately 1 mile (1.6 km) outside of the JBNERR along the southern shore of Puerto Rico. The sampling was performed during one-day sampling events over four seasons between May 2012 and November 2013 (Tetra Tech, 2013a; 2013e; 2013g; and 2014e). A list of the ichthyoplankton larvae collected during these events is provided in table 4.5.4-1.

The total fish larvae densities ranged from an average of 29 to 158 larvae per 26,400 gallons (100 m^3) during the winter, spring, summer, and fall sampling (Tetra Tech, 2013a, 2013e, 2013g, and 2014e). This estimate is lower than the mean abundance of fish larvae (418 individuals per 26,400 gallons [100 m^3]) collected during day samples over a course of a year at the Aguirre Intake Station (Washington Engineers PSC, 2005) and the 180 fish larvae per 26,400 gallons (100 m^3) reported prior to the operation of the APPC (Youngbluth, 1974). The fish larvae sampled, as described by Tetra Tech (2014b), were identified to the lowest practical taxa (typically family).

Relatively high abundances of fish eggs were collected during the winter, spring, and summer sampling at the proposed terminal site (Tetra Tech, 2014b). This could be a result of long-shore transport of eggs from coastal reefs and pelagic waters in and around Boca del Infierno pass and from adjacent seagrass habitat serving as spawning habitat for many fish species. The fish egg densities were particularly high during the summer sampling event, potentially as a result of the lunar spawning activities of serranids, sciaenids, and other common fish species in Puerto Rican waters (Sale, 1993). The average egg densities were 169, 401, 1,475, and 96 eggs per 26,400 gallons (100 m^3) during the winter, spring, summer, and fall samplings, respectively (Tetra Tech 2013a, 2013e, 2013g, and 2014e). The density of eggs (1.475 per 26,400 gallons [100 m^3]) collected in summer was comparable with the mean abundance of eggs collected near the APPC at 2,252 eggs per 26,400 gallons (100 m^3) during day samplings and 1,711 larvae per 26,400 gallons (100 m^3) during night samplings (PREPA, 2005). For this study (Tetra Tech, 2014b), eggs were not differentiated based on shape and thus were not identified to a specific taxa.

Table 4.5.4-2 lists the mean densities of several key taxa of concern, based on the results of the Aguirre LLC's seasonal sampling events. These key taxa are assessed in the entrainment analysis described in section 4.5.4.3 and appendix E.

TABLE 4.5.4-1

Species of Ichthyoplankton Collected by Aguirre LLC at the Proposed FSRU Location for the Aguirre Offshore GasPort Project Area

Family	Common Name	Family	Common Name
Antennariidae	Frogfishes	Mugiliformes	Mugilidae
Apogonidae	Cardinalfishes	Myctophidae	Myctophids
Atherinidae	Silversides	Nemichthyidae	Snipe eels
Aulostomidae	Trumpetfishes	Ophichthidae	Snake eels
Balistidae	Triggerfishes	Ophidiidae	Cusk-eels
Berycidae	Redfishes / Alfonsinos	Opistognathidae	Jawfishes
Bleniidae	Blennies	Ostraciidae	Trunkfishes
Bothidae	Left-eye Flounders	Pleuronectiformes	Flounders
Bythitidae	Brotulas	Pomacanthidae	Angelfishes
Callionymidae	Dragonets	Pomacentridae	Damselfishes
Carangidae	Jacks	Scaridae	Parrotfishes
Clupeidae / Engraulidae	Sardines / Anchovies	Sciaenidae	Drums / Croakers
Coryphaenidae	Dolphinfishes	Scombridae	Tunas / Mackerels
Eleotridae	Sleepers	Scorpaenidae	Scorpionfishes
Ephippidae	Spadefishes	Serranidae	Sea Basses / Groupers
Exocoetidae	Flying fishes	Sparidae	Porgies
Gerreidae	Mojarras	Sphyraenidae	Barracudas
Gobiesocidae	Clingfishes	Syngnathidae	Pipefishes
Gobiidae	Gobies	Synodontidae	Lizardfishes
Haemulidae	Grunts	Tetraodontidae	Porcupinefishes
Hemiramphidae	Half-beaks	Tripterygiidae	Triplefin Blennies
Labridae	Wrasses	Unknown Beloniformid	--
Lutjanidae	Snappers	Unknown fish larvae	--
Microdesmidae	Wormfishes	Fish egg	--
Monacanthidae	Filefishes		

Source: Tetra Tech, 2013a; 2013e; 2013g; and 2014e

TABLE 4.5.4-2

Densities (no. of individuals) of Representative Taxa of Concern Chosen for Entrainment Calculations in the Project Area

Taxa (Eggs and/or Larvae)	Common Name	Mean Winter Density		Mean Spring Density		Mean Summer Density		Mean Fall Density	
		no./100 m^3	no./MG	no./100 m^3	no./MG	no./100 m^3	no./MG	no./100 m^3	no./MG
Lutjanidae	Snappers	1	47	2	65	1	49	0	-
Serranidae	Groupers and Sea basses	0.4	16	0.2	6	0	-	0.4	15
Carangidae	Jacks	0	-	1	31	0.1	6	0	
Haemulidae	Grunts	4	167	5	191	1	49	2	68
Palinura	Spiny lobsters	3	110	0.2	9	1	45	1	36
Total fish eggs	--	169	6,413	401	15,173	1,475	55,845	96	3,651
Unidentified and other fish larvae	--	45	1,708	80	3,040	155	5,872	27	1,006
Other invertebrate larvae	--	1,151	43,573	1,481	56,068	1,629	61,661	1,847	69,907

MG = million gallons (1 MG = 3,785 m^3)

Coral Larvae

Different species of coral utilize a variety of reproductive techniques. In the Caribbean, many of the reef-building corals either engage in brooding or broadcast spawning. In brooding species, fertilization occurs within maternal polyps containing egg cells, and the larvae remain there until an advanced stage of development. At this point the free-swimming larvae are released and typically settle onto hard substrate near the mother colony. In broadcast spawning species, eggs and sperm are released into the water column in large numbers. The buoyant eggs and sperm float toward the water surface and join to form larvae that spend days to weeks in the water column before developing into a free-swimming stage. After reaching this stage, the larvae migrate downward in the water column, settle to the bottom, and attach to hard substrate.

Many of the coral species in the Project area engage in mass spawning, a synchronized event where many species release their eggs and sperm at the same time. This event typically occurs 3 to 8 days after the full moon following the warmest month (typically, August, September, or October). Table 4.5.4-3 summarizes the method and timing of reproduction, as well as the timing of larval development, for the coral species in the Project area that are ESA-listed or species proposed for ESA listing.

TABLE 4.5.4-3

Timing and Method of Reproduction for ESA-Listed Corals

Species [a]	Reproductive Method	Timing of Reproduction [b]	Time to Free-Swimming Larval Stage
Acropora cervicornis (T)	Broadcast Spawning	3 days after August full moon, between approx. 7:00 to 10:30 PM	5 to 7 days
Acropora palmata (T)	Broadcast Spawning	3 to 4 days after August full moon, approx. 9:00 PM	5 to 7 days
Dendrogyra cylindrus (T)	Broadcast Spawning	Not well known; possibly 3 to 4 days after August full moon, approx. 9:00 PM	Unknown
Orbicella annularis (T)	Broadcast Spawning	6 to 7 days after September/October full moon; approx. 10:00 PM	3 to 8 days
Orbicella faveolata (T)	Broadcast Spawning	6 to 7 days after September/October full moon; approx. 10:00 PM	3 to 8 days
Orbicella franksi (T)	Broadcast Spawning	6 to 7 days after September/October full moon; approx. 10:00 PM	3 to 8 days
Mycetophyllia ferox (T)	Brooding	February/March	Released as free-swimming larvae

Sources: Caribbean Marine Biological Institute, 2012; NMFS, 2012; Brainard et al. 2011; Baird et al., 2009; Riddle, 2008

[a] T = Threatened

[b] Peak spawning times are listed, but there can be substantial variability. For example, Adams (2006) notes massive coral spawning in Puerto Rico can occur anywhere between 7 to 15 days after the full moon.

Aguirre LLC is currently developing, in discussion with the NMFS, FWS, DNER, and other appropriate agencies, a pre-operations coral larvae baseline survey and monitoring plan. The plan would analyze population distribution, abundance, and seasonal timing of coral larvae in the Project area. Anticipated Project impacts on coral larvae would be evaluated and discussed with applicable permitting agencies after the baseline study has been completed. Therefore, the site-specific data have not been updated since the draft EIS.

In order to provide site-specific data on coral larvae densities in the vicinity of the proposed FSRU during periods of regular spawning activity, a sampling event was undertaken by Aguirre LLC between August 20 and 28, 2013 (Tetra Tech, 2014c). This period was chosen to coincide with the August 2013 spawning event predicted to take place after the monthly full moon. While the proposed FSRU would be over a benthic habitat that consists primarily of coarse sand with isolated corals occurring at low densities, the concentrated area of coral reefs found at Boca del Infierno pass (approximately 1 mile to the east) must be considered when determining potential impacts from the Project (NMFS, 2012; Tetra Tech, 2012).

The subsurface plankton tow Aguirre LLC used collected free-swimming larvae of many cnidarians including anemones, coral, and octocoral (most of which are 0.01 to 0.03 inches [300 to 700 micrometers] in size and collected with nets 0.01 inches [300 micrometers] mesh or smaller) (Tetra Tech, 2014c). While it is possible to distinguish anemone larvae from coral and octocoral under a microscope, it is difficult to distinguish between coral and octocoral and even more difficult to distinguish between coral families, genera, and species based on morphological features of the larvae. Most coral species are indistinguishable from one another until they settle to the bottom. Genetic analyses, which were not performed in this sampling, could be used to determine which species are present. However, in addition to not distinguishing between the ESA-listed corals (table 4.5.4-2) in the area, it was not possible to determine their density for a number of reasons, including: (a) a high diversity of hard and soft coral in the water column at the sampling depths (23 to 26 feet [7 to 8 m]; i.e., depth of the FSRU intakes) during the period of August and September (e.g., ESA species are not the only ones present), and (b) larvae are found in patchy, heterogeneous aggregations and undergo daily vertical migrations (Oliver and Willis, 1987; Richmond, 1997; Jones et al., 2010) increasing the difficulty in collecting them in tows (Tetra Tech, 2014c). Therefore, a gross density estimate of total coral larvae (i.e., total number per 26,400 gallons [100 m^3]) was derived and compared with representative larvae densities from previous studies.

During a nine-day period just before and following the full moon in August 2013, pre-spawn and post-spawn sampling using bongo nets with single diurnal and nocturnal tows was conducted along a single transect passing through the proposed moorage point for the FSRU (Tetra Tech, 2014c). Tows were conducted every second day during the sampling period. No coral larvae were detected during either the diurnal or nocturnal surveys on the first 3 days of sampling (August 22, 24, or 26). However, local anecdotal information indicated coral slicks were apparent along the southwestern Puerto Rican shore on August 24. Coral larvae were first detected on August 28 with an estimated 456 larvae collected in the nocturnal tow. However, no further sampling was conducted after this tow so it is not possible to track densities after that point. Therefore, the range of density resulting from this one day of the sampling period was 0.085 coral larvae per 264 gallons (1 m^3) during the day and 5.31 larvae per 264 gallons (1 m^3) during the night. The range of coral larvae density (0 to 531 larvae per 26,400 gallons [100 m^3]) observed in Tetra Tech (2014c) is below that found in studies over natal reef conglomerate for other reef ecosystems (e.g., Pacific Ocean), where densities ranged from 10,000 to 1,000,000 per 26,400 gallons (100 m^3) (Hodgson, 1985; Oliver et al., 1992). However, the estimated high density of 531 larvae per 26,400 gallons (100 m^3) is more consistent with those observed in non-reef aggregate water or perimeter areas and where drift densities are remotely transported from a natal reef assemblage (Hodgson, 1985).

4.5.4.3 General Impact and Mitigation

Construction of the Project would result in short-term, minor adverse impacts on plankton from hydrostatic testing, sediment resuspension, and the use of vacuum pumps to lower the pipeline, and short-term, moderate adverse impacts from potential inadvertent spills of hydrocarbon materials. Operation of the Project would result in permanent, minor adverse impacts on a localized area for plankton from thermal plume discharge, lighting, and potentially anti-fouling agents, permanent, minor impacts on the plankton community due to loss of individuals entrained in sea water intakes; and short-term, moderate adverse impacts from potential inadvertent spills of hydrocarbon materials, as described further below.

Hydrostatic Testing

Hydrostatic testing procedures, general impacts, and mitigation measures are described in section 4.5.2.4. Seawater intakes would entrain or impinge some eggs and larvae against the intake screen. The mortality rate of all entrained organisms is assumed to be 100 percent. Although hydrostatic testing would result in a loss of plankton from the ecosystem, the impact is expected to be minor due to the relatively small volume of water affected and the short-term nature of these testing events.

Sediment Resuspension

General impact and mitigation information regarding sediment resuspension is discussed in section 4.5.2.4. An increase in turbidity due to sediment resuspension from installation of the proposed moorings and pipeline has the potential to adversely affect plankton. In particular, demersal eggs or larvae could be smothered as resuspended sediments settle back to the bottom. Turbidity-related impacts can include reductions in growth and feeding rates, the clogging of respiratory structures, and/or death. Overall, turbidity increases during construction would be temporary in duration and localized in scope, so the impact on plankton is expected to be minor and short-term. However, persistent siltation and turbidity from scour and sediment deposition could occur around the permanent pilings or where concrete mats are laid along the seafloor. Water discharges from the LNG carriers could also cause sediment resuspension at the Offshore GasPort during operation. Turbidity increases associated with scour around the permanent pilings and the LNG carrier discharges would be localized in scope, so the impact on plankton is expected to be permanent but minor.

Inadvertent Hydrocarbon Spills

General impact and mitigation information regarding inadvertent hydrocarbon spills are described in section 4.5.2.4. Minor releases of hydrocarbons during construction could result in short-term, minor to moderate adverse impacts on plankton. Accidental releases of hydrocarbons resulting from operation of the Project are expected to have short-term and minor to moderate impacts on plankton, but population-level effects from the loss of a cohort of plankton could be permanent. However, given the vessels use of spill response procedures, we conclude that hydrocarbon spill impacts are unlikely.

Anti-fouling Agents

To prevent macrofouling of the FSRU's raw water intake systems, the FSRU would utilize its on-board copper-aluminum anode MGPS. General impact and mitigation information regarding the anti-fouling system are described in section 4.5.2.4.

Organisms have different mechanisms by which they cope with and process copper. Generally, copper is actively regulated in fish, decapod crustaceans, and algae (Guardiola et al., 2012). Phytoplankton species have different sensitivities to copper toxicity: resistance (diatoms), intermediate sensitivity (Coccolithophore and dinoflagellates), and most sensitive (cyanobacteria; Guardiola et al., 2012).

The MGPS would release copper effluent at the FSRU within the EQB Class SB/SC water quality standard for copper discharge. Therefore, the resulting concentrations of copper effluent are not expected to cause adverse effects on plankton. However, plankton in the immediate vicinity of the outfall may potentially be exposed to concentrations of copper ions, but these effects would be very limited due to the small zone of potential exposure and the ability for copper to bind to organic materials making it less bioavailable.

Lighting

Lighting procedures, general impacts, and mitigation information are described in section 4.5.3.3. The response of plankton to artificial lights can be quite variable depending on a number of factors such as the type of organism, species, and the intensity of the light. For example, artificial lighting may decrease the daily vertical migration of zooplankton that come to the surface to feed on phytoplankton under the cover of darkness. The effect of operational lighting on plankton is expected to be permanent but minor, due to the highly localized nature of the impact. We are recommending in section 4.5.3.3 that Aguirre LLC develop a lighting plan that identifies specific measures that would be implemented to minimize or avoid impacts associated with nighttime lighting.

Thermal Plume Discharge

General impacts and mitigation information regarding thermal plume discharge from the Offshore GasPort are discussed in section 4.5.2.4. Plankton species that undergo vertical migrations are typically exposed to a wide range of water temperatures and show an increased level of thermal tolerance (Myers et al., 1986). However, some plankton species (including planktonic fish and invertebrates) could be killed by a sudden increase in temperature. Plankton that are not able to move away from the zone of increased temperature are likely to be affected by thermal stress, and may be killed. Mobile aquatic organisms can track temperature change and fine-tune their temporal and spatial distribution (EPA, 2014c). Biota can sometimes avoid adverse thermal impacts by seeking out localized areas of cooler waters; however, they may have a difficult time doing this in a homogenous environment like an open water column where the biota does not have access to refugia (EPA, 2014c). Phytoplankton community taxonomic structure near thermal outfalls can be altered as an indirect effect of thermal discharge, and in general, support different communities of algae than those present in the background waters (EPA, 2014c).

The impacts of the thermal plume on plankton would be localized to a relatively small area and would represent a minor impact on the overall plankton community in the region.

Seawater Intake

The two main sources of potential entrainment for plankton from the proposed Project are the water use at the FSRU intakes and at the LNG carriers while at berth at the Offshore GasPort. Ichthyoplankton (including shellfish) and coral larvae are the two main types of plankton that would have the highest potential for impact; thus, an entrainment analysis was performed for these two groups. It is assumed that all pelagic eggs and larvae in the intake water would be entrained and suffer mortality. The ichthyoplankton and coral larvae entrainment calculations in the following section were provided for the draft EIS and have not changed. Aguirre LLC is currently developing, in discussion with the NMFS, FWS, DNER, and other appropriate agencies, pre-operations ichthyoplankton and coral larvae baseline survey and monitoring plans. The plan would analyze coral larvae and ichthyoplankton population distribution, abundance, and seasonal timing in the Project area. Anticipated Project impacts associated with water use for construction and proposed facility operations would be evaluated and discussed with applicable permitting agencies after the baseline study has been completed. Therefore, the coral larvae and ichthyoplankton entrainment and impact numbers have not been changed since the draft EIS.

The entrainment estimates were calculated based on the anticipated water uses for the proposed FSRU and LNG carriers. As discussed in section 4.3.1.3, there is a range in the potential daily operating intake volumes for the LNG carriers (based on values derived from past projects). Given the type and size of the LNG carriers in the current fleet, the higher end of that range is most likely to be representative of the Project. Thus, for the purposes of the analysis, the maximum LNG carrier intake volume of 81.6 mgd (308,900 m^3) was used to estimate entrainment. We assumed that there would be 50 deliveries per year and each delivery would take 88 hours.

Ichthyoplankton

Aguirre LLC conducted an evaluation to estimate the annual entrainment impact in terms of equivalent adult losses for the Project using the four seasonal sampling events collected to date (Tetra Tech, 2014b). However, Aguirre LLC's study was inadequate because it did not include age-specific mortality or survival rates necessary to accurately convert raw entrainment and impingement numbers into age-1 equivalents. Thus, we conducted a separate equivalent loss analysis to estimate potential entrainment impacts on fish and spiny lobster eggs and larvae associated with seawater intakes during GasPort operations. Note that entrainment impacts were calculated for the operational phase of the Project only, as data on water use during construction were not provided. The full analysis is provided in appendix E and is summarized briefly below.

The entrainment calculations were performed in part by following the NOAA/USCG jointly developed methodology for ichthyoplankton entrainment, as described in the ichthyoplankton assessment model appended to the Gulf Landing Final Environmental Impact Statement (USCG and U.S. Maritime Administration, 2005 and subsequent revisions/clarifications). Not all of the steps described in this guidance were applicable for this Project due to lack of extensive seasonal ichthyoplankton sampling.

A selection of specific species and taxa of concern were analyzed to serve as indicators of the potential entrainment impacts of the Project. The species/taxa analyzed for the ichthyoplankton entrainment assessment were chosen due to their adequate life history information and their ecological and economic importance. The density information, based on the towed ichthyoplankton net sampling as described in Tetra Tech (2014b), is only down to the family level. Thus, specific species within each of the key taxa were selected and used as proxies for the life history inputs necessary to derive age-one equivalents and growth and production foregone for lost individuals. Table 4.5.4-4 lists the taxa of concern chosen for the entrainment analysis and their respective proxy species for life history inputs. For the entrainment calculations of fish eggs and unidentified and other fish larvae, two proxy species were used for life history inputs in order to derive a range of growth and production foregone for lost individuals. Because the "other invertebrate larvae" category is comprised of a wide range of taxa, no one proxy species could be chosen for life history inputs; thus, only raw entrainment numbers were calculated for this group.

Tables 4.5.4-5 and 4.5.4-6 present the results of the entrainment analysis for the FSRU and LNG carriers, respectively. These tables include the raw number individuals entrained, the number of age-1 equivalents lost, and losses of age 1+ age classes per year and over the life of the Project, which was assumed to be 40 years.

TABLE 4.5.4-4

Representative Taxa of Concern Chosen for Entrainment Calculations at the Project Location

Taxa (Eggs and/or Larvae)	Common Name	Proxy Species for Life History Inputs	Rationale for Consideration
Lutjanidae	Snappers	Silk snapper	Target reef fish in the commercial fishery
Serranidae	Groupers and Sea basses	Nassau grouper	Important continental shelf taxa
Carangidae	Jacks	Blue runner	High recreational landings as listed in the Shallow Water Reef Fish Fishery Management Plan (FMP)[a]
Haemulidae	Grunts	Tomtate grunt	High recreational landings as listed in the Shallow Water Reef Fish FMP
Palinura	Spiny lobsters	Caribbean spiny lobster	Important continental shelf taxa
Fish Eggs	--	Engraulidae (bay anchovy) and Haemulidae (tomtate grunt)	Both abundant species in sampling events, thus prevalent in the area
Unidentified and All Other Fish Larvae	--	Engraulidae (bay anchovy) and Haemulidae (tomtate grunt)	Majority of fish larvae collected during seasonal sampling [b]
All Other Invertebrate Larvae	Decapods, Mollusks and Cephlapods	-	Majority of invertebrate larvae collected during seasonal sampling

Sources:
[a] Caribbean Fishery Management Council, 1985
[b] Tetra Tech, 2013a; 2013e; 2013g; and 2014e

TABLE 4.5.4-5

Annual Population Impacts Under FSRU Continuous Operations

Taxa	Common Name	Stage	No. Individuals Lost (millions) Annually	No. Individuals Lost (millions) Project Life [a]	No. Age-1 Equivalents Lost Annually	No. Age-1 Equivalents Lost Project Life [a]	Losses of Age 1+ Age Classes (pounds [kilograms]) Annually	Losses of Age 1+ Age Classes (pounds [kilograms]) Project Life [a]
Lutjanidae	Snappers	Larvae	0.8	32.9	0.13	5.4	0.28 (0.13)	11.2 (5.1)
Serranidae	Groupers	Larvae	0.2	7.6	0.01	0.2	0.03 (0.01)	1.0 (0.5)
Carangidae	Jacks	Larvae	0.2	7.4	0.04	1.5	0.08 (0.04)	3.2 (1.4)
Haemulidae	Grunts	Larvae	2.4	96.6	0.03	1.3	0.22 (0.10)	9.0 (4.1)
Palinura	Spiny lobster	Larvae	1.0	40.7	0.04	1.5	0.06 (0.03)	2.5 (1.4)
All other fish taxa as Engraulidae	Anchovies	Larvae	59.5	2,379.7	0.46	18.5	0.22 (0.10)	9.0 (4.1)
All other fish taxa as Haemulidae	Grunts	Larvae	59.5	2,379.7	0.78	31.3	5.52 (2.50)	220.8 (101.1)
Fish eggs as Engraulidae	Anchovies	Eggs	333.8	13,353.6	2.60	104.0	28.56 (12.96)	1,142.5 (518.2)
Fish eggs as Haemulidae	Grunts	Eggs	333.8	13,353.6	4.39	175.7	30.97 (14.05)	1,238.8 (561.9)

[a] The Project life was assumed to be 40 years.

TABLE 4.5.4-6

Annual Population Impacts Associated with LNG Carrier Deliveries

Taxa	Common Name	Stage	No. Individuals Lost (millions)		No. Age-1 Equivalents Lost		Losses of Age 1+ Age Classes (pounds [kilograms])	
			Annually	Project Life [a]	Annually	Project Life [a]	Annually	Project Life [a]
Lutjanidae	Snappers	Larvae	0.6	24.2	0.10	3.9	0.21 (0.09)	8.3 (3.7)
Serranidae	Groupers	Larvae	0.1	5.6	0.00	0.2	0.02 (0.01)	0.7 (0.3)
Carangidae	Jacks	Larvae	0.1	5.4	0.03	1.1	0.06 (0.03)	2.3 (1.1)
Haemulidae	Grunts	Larvae	1.8	71.0	0.02	0.9	0.16 (0.07)	6.6 (3.0)
Palinura	Spiny lobster	Larvae	0.7	30.0	538.62	1.1	0.05 (0.02)	1.8 (0.8)
All other fish taxa as Engraulidae	Anchovies	Larvae	43.5	1,739.3	0.34	13.5	0.16 (0.07)	6.6 (3.0)
All other fish taxa as Haemulidae	Grunts	Larvae	43.5	1,739.3	0.57	22.9	4.03 (1.83)	161.3 (73.2)
Fish eggs as Engraulidae	Anchovies	Eggs	243.4	9,737.3	1.90	75.9	20.83 (9.45)	833.1 (377)
Fish eggs as Haemulidae	Grunts	Eggs	243.4	9,737.3	3.20	128.1	22.58 (10.24)	903.3 (409.7)

[a] The Project life was assumed to be 40 years.

Based on the results of the ichthyoplankton entrainment analysis, annual losses of age 1+ fish and invertebrates are relatively low. However, these entrainment estimates need to be used with the caveat that they are only based on four one-day seasonal sampling events to derive fish and invertebrate plankton densities. Based on the information available, operation of the Project would result in a permanent, minor impact on fish and shellfish populations in the region due to entrainment. The loss of planktonic fish and shellfish due to entrainment would also result in a reduction in food availability for fish and invertebrates species that prey on these items. This impact is expected to be permanent but minor.

Aguirre LLC is in the process of developing, in discussion with the NMFS, FWS, DNER, and other appropriate agencies, a pre-operations ichthyoplankton baseline survey and monitoring plan. The plan would help to further characterize the ichthyoplankton at the proposed GasPort location to understand potential impacts associated with operations of the proposed facility and water use required for construction activity. Once this additional baseline study has been performed, **we recommend that:**

- **Aguirre LLC should consult with the NMFS, FWS, DNER, and other appropriate agencies to develop mitigation measures for entrainment impacts of ichthyoplankton and coral larvae associated with Project operations and required water use. These measures should include a 3-year study to analyze water intake impacts associated with Project operations. In addition, Aguirre LLC should conduct an analysis of potential impingement impacts on Nassau grouper that are larger than larval size that may congregate near the seawater intakes at the Offshore GasPort. Aguirre LLC should file with the Secretary the results of the grouper impingement analysis, the ichthyoplankton and coral larvae baseline survey results and monitoring plan, and the mitigation measures for entrainment impacts prior to implementing Project operations. Aguirre LLC should also file the results of the 3-year water intake impacts study when the analysis is complete.**

Coral Larvae

The six broadcast-spawning species found in the Project area that are ESA-listed (see table 4.5.4-3) would be at risk of being exposed to entrainment over a period of approximately 10 days in August and potentially one week in September/October, depending on the summer water temperature. Larvae at the depth of the FSRU intakes at 23 and 36 feet (7 and 11 m) below the water surface would be at the highest risk of entrainment. Coral gametes could be exposed to entrainment as they are spawned near the bottom, then rise to the surface and return through the water column to settle. There is also the possibility of entrainment as larvae are carried through the water column again due to waves and currents. The larvae of the ESA-listed species that brood (table 4.5.4-3) would potentially be exposed to entrainment impacts after they are released. However, brooded larvae are not buoyant and typically disperse only a short distance from their parent colony, thus their risk of entrainment would be relatively low.

Potential entrainment of coral larvae from the FSRU and calling LNG carriers was estimated based on the minimum (daytime) and maximum (nighttime) density of coral larvae observed in the Tetra Tech (2014c) study. The entrainment estimates of maximum daily entrainment apply only to planktonic coral densities present in the water column following the spawning activity, and should be considered a rough estimate as they are based on a single day of sampling in which larvae were present. In order to determine the number of coral larvae entrained annually, two factors need to be taken into account: 1) two major coral spawning events (August and September-October) have been identified for the southern shore of Puerto Rico; and 2) the duration of larval stage before settlement can range from 2 to 10 days (Baird, 2001). Therefore, the following equation can be used to estimate annual entrainment of coral larvae:

Number of Coral Larvae Entrained Annually (n) = $\Sigma(\text{Larvae}_{day}*0.5\text{day} + \text{Larvae}_{night}*0.5\text{ day})$ *(daily volume withdrawn m^3)*(duration of larval stage)

Where:

- Larvae_{day} = Density of larvae during daytime sampling event from Tetra Tech (2014c): 0.085 larvae/m^3);
- Larvae_{night} = Density of larvae during nighttime sampling event from Tetra Tech (2014c): 5.31 larvae/m^3);
- Daily Volume Withdrawn = Daily water withdrawal by the FSRU or LNG carriers (m^3);
- Duration of Larval Stage = Estimated exposure duration for the coral larvae stage prior to settlement, 10 days (Baird, 2001) for two distinct spawning events.

This estimate assumes larvae would only be present at the depth of the intake 23 to 36 feet (7 to 11 m) during spawning events, which is a conservative assumption. Table 4.5.4-7 summarizes the annual converted entrainment for coral larvae for the FSRU and LNG carriers.

TABLE 4.5.4-7

Qualitative Annual Entrainment Estimate of Coral Larvae by Offshore GasPort FSRU and LNG Carriers for the Aguirre Offshore GasPort Project Area

Operating Scenario	Daytime Coral Larvae Density (no./m^3) [a]	Nighttime Coral Larvae Density (no./m^3) [a]	Duration of Larval Susceptibility to Entrainment (days)	Maximum Daily Entrainment Estimate (no. of individuals)	Annual Entrainment Estimate (no. of individuals)
FSRU	0.085	5.31	20 [b]	571,417	11,428,336
LNG Carriers	0.085	5.31	12.7 [c]	833,231	10,582,031

[a] Source: Tetra Tech (2014c); total coral larvae collected on one sampling event – 28 August 2013

[b] Assumes two major spawning events per year with 10-day larval duration during each event.

[c] Assuming 50 deliveries per year that are evenly spaced, one delivery would occur every 7.3 days. Therefore, a maximum of 1.7 deliveries (3.67 days in duration each) could occur during each of the two 10-day spawning events.

Equivalent adult analyses used in estimating entrainment impacts for fish cannot be used for coral larvae due to the lack of known population level parameters, the short temporal period for the pelagic stage, and the complex development of coral larvae from pelagic to sessile organisms. As a result, these annual entrainment estimates in table 4.5.4-7 could be considered conservative because they do not account for natural mortality of the larvae. However, these entrainment estimates need to be used with the important caveat that they are based on one day of sampling within a nine day sampling event in August 2013, which may not represent typical post-spawning larval densities.

During spawning periods, there is potential for entrainment of coral larvae with the highest risk occurring near the depth of the intake of the FSRU. Entrainment of coral larvae would likely result in a permanent, moderate impact on coral populations in the region.

The coral entrainment analysis used data based on one day of sampling within a 9-day sampling event in August 2013, which may not represent typical post-spawning larval densities. Aguirre LLC is currently developing, in discussion with the NMFS, FWS, DNER, and other appropriate agencies, a pre-operations coral larvae baseline survey and monitoring plan. The plan would help to further characterize the coral larvae at the proposed GasPort location to understand the potential impacts associated with proposed water use for construction activity and operations of the Gasport facility. As stated above, once this additional baseline study has been performed and prior to implementing Project operations, we are recommending that Aguirre LLC develop mitigation measures for entrainment impacts of coral larvae and ichthyoplankton.

4.5.5 Fisheries Resources

The Jobos Bay estuary and the offshore waters of the Caribbean Sea provide valuable habitat for a variety of tropical fish species. Common fish species found within Jobos Bay include anchovies, barracuda, jacks, tarpon, wrasses, damselfish, grunts, snappers, surgeonfishes, and parrotfish.

Tropical fish species are present both in the Jobos Bay estuary and in the Caribbean Sea. Estuaries are protected nearshore areas such as bays, sounds, inlets, and river mouths, influenced by both ocean and freshwater. Because of tidal cycles and freshwater runoff, salinity varies within estuaries and results in great diversity, offering freshwater, brackish, and marine habitats within close proximity. Estuaries tend to be shallow, protected, nutrient rich, and are biologically productive, providing important habitat for marine organisms.

4.5.5.1 Fisheries of Special Concern

Fisheries resources of special concern occurring within the Project area include:

- federally designated EFH for corals, queen conch, spiny lobster, reef fish, and highly migratory species;
- species listed as federally threatened, endangered, proposed, or candidate under the ESA and their designated or proposed critical habitat;
- species listed as species of concern by NMFS; and
- fisheries protected under the NMFS annual catch limit regulations.

EFH within the Project area is discussed in section 4.5.5.2, and ESA-listed species and their critical habitats are discussed in section 4.6. Fishery species protected under annual catch limit regulations are discussed in section 4.5.5.3. The NMFS species of concern are discussed below.

Species of concern are defined as those species with insufficient information to require listing under the ESA; however, NMFS has concerns regarding status and threats of the species. These species are not protected under the ESA; however, the designated status is in place to draw attention and conservation actions to the species. One species of concern, the dusky shark, has the potential to occur in the Project area.

The dusky shark is listed as a species of concern in the western Atlantic by NMFS, although its range includes all waters surrounding Puerto Rico. This species is a highly migratory coastal shark that is found in inshore surf zones and offshore water. Reasons for decline include illegal commercial and recreational shark fisheries and by-catch. The dusky shark matures late in life, grows slowly, and only reproduces every 3 years, making it very susceptible to overfishing (NMFS, 2010c). The Project would not contribute to commercial or recreational fishing within the Project area, as discussed in section 4.5.5.3. Therefore, Project impacts on the dusky shark would be similar to those actions described below for EFH species and would not be significant.

4.5.5.2 Essential Fish Habitat

The MSA (Public Law 94-265 as amended through October 11, 1996) was established, along with other goals, to promote the protection of EFH in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. EFH is defined in the MSA as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.

Federal agencies that authorize, fund, or undertake activities that may adversely impact EFH must consult with NMFS. Although absolute criteria have not been established for conducting EFH consultations, NMFS recommends consolidated EFH consultations with interagency coordination procedures required by other statutes, such as NEPA, the Fish and Wildlife Coordination Act, and the ESA in order to reduce duplication and improve efficiency (50 CFR 600.920(e)). Generally, the EFH consultation process includes the following steps:

1. Notification – The action agency should clearly state the process being used for EFH consultations (e.g., incorporating EFH consultation into an EIS).

2. EFH Assessment – The action agency should prepare an EFH Assessment that includes both identification of affected EFH and an assessment of impacts. Specifically, the EFH Assessment should include:

    - a description of the proposed action;
    - an analysis of the effects (including cumulative effects) of the proposed action on EFH, the managed fish species, and major prey species;
    - the federal agency's views regarding the effects of the action on EFH; and
    - proposed mitigation, if applicable.

3. EFH Conservation Recommendations – After reviewing the EFH Assessment, NMFS should provide recommendations to the action agency regarding measures that can be taken by that agency to conserve EFH.

4. Agency Response – Within 30 days of receiving the recommendations, the action agency must respond to NMFS. The action agency may notify NMFS that a full response to the conservation recommendations will be provided by a specified completion date agreeable to all parties. The response must include a description of measures proposed by the agency to avoid, mitigate, or offset the impact of the activity on EFH. For any conservation recommendation that is not adopted, the action agency must explain its reason to NMFS for not following the recommendation.

We are consolidating EFH consultations for the Project with the EIS process.

Identification of Essential Fish Habitat

EFH potentially affected by the Project was identified through review of the NMFS and Caribbean Fishery Management Council (CFMC) regulations. The CFMC manages the Fishery Management Plans (FMP) for several species in the Project area including queen conch, spiny lobster, corals, and reef fish. Highly migratory species are managed by NMFS, and specific geographic boundaries are defined as EFH for each individual species (NMFS, 2009). According to the 1998 EFH Generic Amendment to the FMPs of the U.S. Caribbean, EFH for these species is identified as "all waters and substrates (mud, sand, shell, rock, and associated biological communities), including coral habitats (coral reefs, coral hardbottoms, and octocoral reefs), sub-tidal vegetation (seagrasses and algae) and adjacent intertidal vegetation (wetlands and mangroves). Therefore, EFH includes virtually all marine waters and substrates (mud, shell, rock, coral reefs, and associated biological communities) from the shoreline to the seaward limit of the EEZ" (CFMC, 1998).

<u>Queen Conch</u>

The queen conch EFH is designated within all marine waters and substrates for post-egg and larval life stages within the Project area. Queen conch within the EEZ are managed by the CFMC under the FMP for the queen conch resources of Puerto Rico and the U.S. Virgin Islands (CFMC, 1996). The queen conch is an ESA-listed candidate species and is discussed in detail in section 4.6.1.5. Annual catch limit regulations for the queen conch are discussed in section 4.5.5.3.

<u>Spiny Lobster</u>

The spiny lobster EFH is designated within all marine waters and substrates for post-egg and larval life stages within the Project area. Two species are included in the EFH designation: the spiny lobster and the slippery lobster. Spiny lobster within the EEZ are managed by the CFMC under the FMP for the spiny lobster fishery of Puerto Rico and the U.S. Virgin Islands (CFMC, 1981). The spiny lobster and its annual catch limit regulations are discussed in section 4.5.5.3.

Reef Fish

The reef fish EFH is designated within all marine waters and substrates for post-egg and larval life stages within the Project area. Six groups of reef fish with a total of 43 species are included in the EFH designation. The six groups include triggerfish, jacks, wrasses, snappers, tilefish, and groupers. Reef fish within the EEZ are managed by the CFMC under the FMP for shallow water reef fish fishery of Puerto Rico and the U.S. Virgin Islands (CFMC, 1985). Reef fish and their annual catch limit regulations are discussed in section 4.5.5.3.

Coral

The coral EFH is designated within all marine waters and substrates for post-egg and larval life stages within the Project area. Corals within the EEZ are managed by the CFMC under the FMP for corals and reef associated plants and invertebrates of Puerto Rico and the U.S. Virgin Islands (CFMC, 1994). Coral reefs are discussed in section 4.5.2.1, and ESA-listed coral species are discussed in section 4.6.

Highly Migratory Species

The EFH for highly migratory species in the Project area has been designated for individual species due to their highly variable life histories. Four highly migratory species have designated EFH within the Project area: lemon shark, sailfish, longbill spearfish, and tiger shark. Highly migratory species are managed by the NMFS Highly Migratory Species Management Division (NMFS, 2009).

4.5.5.3 Commercial and Recreational Fisheries

Jobos Bay and the Caribbean Sea support a number of valuable commercial and recreational fisheries. Commercial fishing in Puerto Rico is generally small scale and limited to coastal areas. Recreational fishing occurs within Jobos Bay and in offshore waters. Common commercial and recreational fish species in the Project area include whalebone anchovies, herring, jacks, conch, octopus, lobster, and parrotfish (DNER, 2010). Over the last few decades, local fisheries have suffered from overfishing from legal and illegal fishing practices and habitat loss. Information on recreational and commercial fishing in the Project area is included in section 4.7.

Finfish landings make up a majority of the commercial fisheries in Puerto Rico, although invertebrate landings have increased over time as a result of declining finfish landings (NMFS, 2011a). Commercial fishing is done by using a variety of fishing gear, including hand lines, fish traps, wooden cage traps, gill nets, trammel nets, horizontal and vertical longlines, trolling, harpoons, snares, gaffs, and hand gathering. Recreational fishing for various estuarine species listed above is done by hand-line or rod and reel fishing. Pelagic species such as dolphin fish, wahoo, billfish, and tuna are fished by boat trolling. Skin-diving fishing is also utilized for recreational fishing in deep waters or shelf edge reefs.

Several fisheries are regulated under annual catch limits developed by NMFS and the CFMC to prevent overfishing resulting from commercial and recreational fishing practices in the federal waters of the U.S. Caribbean. These regulated fisheries include reef fish, spiny lobster, queen conch, and corals and reef associated plants and invertebrates (NMFS, 2011a).

Spiny Lobster Fishery

The spiny lobster occurs throughout the Caribbean Sea and the western Atlantic Ocean and Gulf of Mexico in the southern United States and northern South America. Caribbean spiny lobsters occupy several habitat types throughout their life cycle. Adult lobsters utilize offshore environments, living in social groups and utilizing rock outcrops, reef holes, or artificially created structures as closed den habitat. Larvae are released near reef edges or coastal shelves and spend 6 to 10 months in a series of planktonic larval stages which distribute them throughout the Caribbean. Young lobsters often inhabit clusters of red algae, seagrass beds, sponges, or submerged mangrove roots which provide refuge and food sources. Juvenile and sub-adult lobsters utilize coral reefs, caves, and sponges for habitat. Caribbean spiny lobsters will migrate in single-file lines to deeper water to avoid stressful environments such as cold and turbid water (NMFS, 2005).

On average, the spiny lobster represents approximately half of all invertebrate commercial landings within the Caribbean. The spiny lobster fishery comprised approximately nine percent of the total commercial landings in Salinas and Guayana municipalities between 1993 and 2003. Historically, spiny lobsters were primarily caught using fish or lobster pots and traps; however, in recent years commercial fishermen have utilized diving as a primary method to capturing these species. Commercial landings for the spiny lobster have shown a general decreasing trend.

Caribbean spiny lobsters utilize a variety of habitat types that are present throughout the Project area including coral reef, algal and seagrass beds, mangroves, and offshore habitat. No Caribbean spiny lobsters were documented within Jobos Bay during benthic surveys conducted in June 2009 (Whitall et al., 2011). Aguirre LLC performed additional benthic surveys within the Project area in May 2012, during which, two sub-adult individuals were documented within coral reef habitat.

Queen Conch Fishery

The queen conch is an ESA-listed candidate species; therefore, its characteristics and distribution throughout the Project area and associated impacts and mitigation are discussed in sections 4.6.1.5 and 4.6.2, respectively. This species matures late in life, grows slowly, and reproduces in groups in shallow water, making it very susceptible to overfishing. Queen conch are primarily harvested by hand, both commercially and recreationally. Commercial and recreational fishermen are limited to harvesting a limited amount of conch per day and within seasonal timeframes of November 1 to July 31 within territorial waters of Puerto Rico. The CFMC coordinated the Queen Conch Working Group (previously known as the International Queen Conch Initiative) which consists of a group of Caribbean region countries that have common interests in promoting a universal strategy for the management of queen conch resources in the Caribbean (CFMC, 2012).

Reef Fish Fishery

The reef fish FMP is comprised of over 137 reef fish species, of which 55 are associated with the aquarium trade. The reef fish category consists of a variety of different species including snapper, sea bass, grouper, parrotfish, grunts, goatfish, porgies, squirrelfish, tilefish, jacks, surgeonfish, triggerfish, filefish, boxfish, wrasses, and angelfish (CFMC, 1985). The recreational landings for reef fish in Puerto Rico are included in table 4.5.5-1.

TABLE 4.5.5-1

Recreational Reef Fish Landings for Puerto Rico in 2011

Species group [a]	Total Reported Catch [b]	Annual Catch Limit [b]	Percent of Annual Catch Limit
Angelfish	167	4,492	3.7
Aquarium trade	1,405	8,155	17.2
Boxfish	2,477	4,616	53.7
Goliath Grouper	0	0	n/a
Goatfish	277	362	76.5
Grouper	14,830	77,213	19.2
Grunts	2,113	5,028	42.0
Jacks	3,1982	51,001	62.3
Nassau Grouper	221	0	n/a
Parrotfish	10,391	15,263	68.1
Porgies	1,787	2,577	69.3
Snapper Unit 1	39,230	95,526	41.1
Snapper Unit 2	0	34,810	0
Snapper Unit 3	27,896	83,158	33.5
Snapper Unit 4	9,745	28,509	34.2
Squirrelfish	754	3,891	19.4
Triggerfish & Filefish	1,970	21,929	9.0
Wrasses	5,539	5,050	109.7

[a] Snapper Unit 1 includes silk, black, blackfin, vermilion, and wenchman; Snapper Unit 2 includes queen and cardinal; Snapper Unit 3 includes gray, lane, mutton, dog, schoolmaster, and mahogany; Snapper Unit 4 includes yellowtail.

[b] Pounds of whole fish.

Source: NMFS, 2014

Corals and Reef Associated Plants and Invertebrates Fishery

Over 100 species of coral and over 60 species of plants and invertebrates are included in the FMP for corals and reef associated plants. Coral reef characteristics and distribution throughout the Project area are discussed in section 4.5.2.1. Similar information regarding ESA-listed coral species is included in section 4.6.1.5. Seagrasses, hydrocorals, anthozoans, gorgonian corals, hard corals, and black corals are currently prohibited from being extracted in the territorial waters of Puerto Rico unless permitted for scientific research, education, or unless restoration is completed. Live rock, snapping shrimp, emerald crab, olive snail, cushion sea star or West Indies starfish, banded shrimp, golden shrimp, yellow arrow crab, and anemone shrimp are all targeted commercially for aquarium trade (CFMC, 1994).

4.5.5.4 General Impacts and Mitigation

Construction of the proposed Project would result in direct and indirect impacts on fisheries. Direct impacts include entrainment of fish larvae, loss or alteration of habitat, and direct mortality of species resulting from construction activities. Indirect impacts as a result of turbidity, noise, water quality, and lighting would also occur. Operation of the Project would result in permanent, minor adverse impacts on fishery resources from increased vessel traffic and entrainment, shading, anti-fouling agents, thermal plume discharge, noise, and lighting; permanent moderate adverse impacts from habitat alteration/loss associated with the pipeline and the placement of concrete mats at various locations along the pipeline; and short-term, moderate adverse impacts from potential inadvertent spills of hydrocarbon materials. Much of the impact discussion included below applies to fish protected under the ESA, which are described in detail in section 4.6, and to EFH designated under the MSA, which is discussed further in section 4.5.5.2. In addition, marine mammals and sea turtles occurring along the waterway for LNG marine traffic are protected under the ESA and/or the MMPA and are described in sections 4.6.1.1 and 4.5.3.1.

In-Water Construction Activities

Fishery resources could be impacted by in-water construction activities such as pile driving and placement and lowering of the subsea pipeline (including the use of vacuum pumps) and the concrete mats. Direct impacts of in-water construction activities on fishery resources would include the displacement of fishery species within the affected area and direct mortality of some individuals. Most fish species are highly mobile and would leave the vicinity of the Project area during construction activities. However, construction activities could cause mortality of less mobile species, including the queen conch if encountered during construction.

Hydrostatic Testing

Hydrostatic testing procedures, general impacts, and mitigation measures are described in section 4.5.2.4. The intake of water would impact fishery resources in the Project area through entrainment and impingement of larvae. The impact of entrainment and impingement of fish larvae is addressed in section 4.5.4.3 and we are recommending that Aguirre LLC develop mitigation measures for entrainment impacts associated with Project operations and required water use. The discharge would be directed through a pipe secured about 6 feet (1.8 m) below the bay's water surface to minimize surface disturbance. To reduce discharge velocity and minimize sediment resuspension at the point of discharge, Aguirre LLC would attach a diffuser head to the discharge pipe during dewatering operations

Sediment Resuspension

General impact and mitigation information regarding sediment resuspension is discussed in section 4.5.2.4. An increase in turbidity due to sediment resuspension from installation of the proposed moorings and pipeline has the potential to affect fishery resources. Increased turbidity can adversely affect fish eggs and juvenile fish survival, benthic community diversity and health, foraging success, and suitability of spawning habitat. Increased turbidity can also reduce in-water visibility that can affect the ability of sight-feeders to locate prey. In sufficient quantities, increased turbidity levels can affect oxygen exchange over the gills in fishery species, resulting in weakened individuals or mortality. Additionally, sediments in the water column can be deposited on nearby substrates, which could bury aquatic macroinvertebrates (an important food source for many species of fish). Overall, turbidity increases due to construction activities would be temporary in duration and localized in scope (see section 4.2.3.2). We are recommending in section 4.5.2.4 that Aguirre LLC include measures in its implementation plan to ensure the effectiveness of the turbidity curtains. Therefore, we anticipate the impact on fishery resources to be short-term and minor. However, persistent siltation and turbidity from scour and sediment deposition could occur around the pilings and potentially where the concrete mats are placed along the pipeline. Water discharges from the LNG carriers could also cause sediment resuspension at the Offshore GasPort during operation. Turbidity increases associated with scour around the pilings, where the concrete mats are placed, and the LNG carrier discharges would be localized in scope, so the impact on fishery resources is expected to be permanent but minor.

Inadvertent Hydrocarbon Spills

General impact and mitigation information regarding inadvertent hydrocarbon spills are described in section 4.5.2.4. Minor releases of hydrocarbons during construction could result in short-term, minor to moderate adverse impacts on fishery resources. Because the construction vessels, the FSRU, and LNG carriers would abide by its respective spill plans, we conclude accidental spills during operation would have negligible impacts on fish species.

Habitat Alteration/Loss

Overall habitat modification impact information and acreages for benthic resources used by fishery resources (seagrasses, corals, and macroalgae) are discussed in section 4.5.2.4. The impact of temporary habitat modification/loss on fishery resources varies. Fish in the offshore portion of the Project area would likely move away from areas of disturbance to other similar, adjacent habitats. Within Jobos Bay, destruction of seagrasses, macroalgae, and coral reef would be a loss of habitat for fishery species.

Seagrasses and macroalgal habitat loss as a result of the Offshore GasPort operation are anticipated to be minor. In addition, Aguirre LLC has committed to conducting mitigation for its impacts on seagrass. The presence of the permanent structure in the offshore could be a beneficial effect for some fish species, as it may provide artificial reef habitat in the offshore coastal waters.

Based on the Project as currently proposed, the Boca del Infierno pass would be altered by the presence of the pipeline which could act as a physical deterrent that bisects the pass. Many fishery species are highly mobile and would not be impacted directly by the presence of the pipeline. However, queen conch are less mobile and could be directly impacted by the portion of pipeline laid along the seafloor in the Boca del Infierno pass from MPs 1.0 to 1.6. Impacts regarding the presence of the pipeline on queen conch and a recommendation to perform post-construction monitoring on queen conch and benthic resources are discussed in sections 4.5.2.4 and 4.6.2.2. Our recommendations that would result in reduced impact within the Boca del Infierno pass would also reduce impacts on fisheries species. With mitigation measures in place, overall habitat impacts during construction are expected to be short-term and minor for most fishery species.

Noise

General impacts and mitigation information, as well as current noise levels and modeling results in the Project area are discussed in section 4.5.3.3. Unfortunately, relatively little is known about the effects from exposure to underwater sound on most aquatic organisms, particularly fish (Popper and Hastings, 2009). Even in cases where data are available, most experts recommend extreme caution in attempting to extrapolate between species (Popper and Hastings, 2009). Studies have shown that caged fish exposed to sounds from an impact driver can lead to injury or death to the fish; however, these studies did not establish appropriate metrics or thresholds for injury (Stadler and Woodbury, 2009). The lack of metrics and thresholds creates a high degree of uncertainty regarding the potential for an individual project to injure fishes (Stadler and Woodbury, 2009). This degree of uncertainty lead to the development of interim criteria for the onset of physical injury to fishes exposed to underwater sounds generated by impact pile driving generated by a working group of federal and state agencies, underwater acoustic experts, and fish biologists (Stadler and Woodbury, 2009). However, these assessments of physical injury to fish exposed to sounds generated by pile driving are in need of further studies to refine the thresholds of effect and provide more certainty (Stadler and Woodbury, 2009). The interim criteria used two metrics including peak sound pressure level and sound exposure level. The interim criteria suggested that onset of physical injury would be expected if either the peak sound pressure level exceeds 206 dB (re: 1 Pa) or the sound exposure level, accumulated over all pile strikes generally occurring within a single day, exceeds 187 dB (re: 1 Pa^2 sec) for fishes 2 grams or larger, or 183 dB for smaller fishes (Stadler and Woodbury, 2009). Section 4.5.3.3 discusses noise associated with Project construction activity and operation.

Fish species with swim bladders seem more susceptible to noise/pressure impacts. However, these fish species are highly mobile and would be able to avoid areas of noise that would cause them discomfort or harm. Potential noise impacts include temporary or permanent impacts on fish auditory systems that could reduce the survival, growth, and reproduction of the affected fish by increasing the risk of predation and reducing foraging or spawning success. Construction impacts could create large volumes of noise/pressures (particularly during the installation of the piles). However, these impacts would be temporary. In the draft EIS we recommended that Aguirre LLC provide minimization measures to limit noise impacts associated with pile driving. In response to this recommendation, Aguirre LLC conducted modeling to determine the anticipated net reduction in noise that would result from the implementation of bubble curtain technology during impact pile driving activities. Table 4.5.3-3 summarizes the distances from impact pile driving techniques to 180 dB both with and without bubble curtain technology. Noise levels of 180 dB associated with impact pile driving would be exceeded within 65 feet (20 meters) from the noise source with the use of bubble curtain technology for both the 80-inch and 24-inch piles. A similar net reduction in noise levels would be expected with the use of bubble curtain technology during vibratory pile driving events. Contractors would be requested to 'ramp-up,' which entails the gradual increase in intensity of a sound source and is a commonly practiced mitigation measure used during pile driving activities. The intent of ramp-up is to either avoid or reduce the potential for instantaneous hearing damage to an animal that might be in close proximity. Increasing sound levels are designed to warn animals of pending operations, and to allow sufficient time for those animals to leave the immediate area. Impacts on fishery resources in the offshore environment from the FSRU and LNG vessels are expected to be permanent but minor given the existing noise conditions in the Project area.

Lighting

Lighting procedures, general impacts, and mitigation information are described in section 4.5.3.3. The response of fishery species to artificial lights can be quite variable depending on a number of factors such as the species, life stage, and the intensity of the light. Small organisms are often attracted to lights, which in turn attract larger predators to feed on the biological aggregations. Lights could cause artificially induced biological aggregations. Generally, impacts on fishery resources would be minor as these species may change their feeding habits based on these aggregations. Overall, with mitigation measures in place, the effect of construction lighting on fishery species is expected to be permanent but minor due to the highly localized nature of the impact. We are recommending in section 4.5.3.3 that Aguirre LLC develop a lighting plan that identifies specific measures that would be implemented to minimize or avoid impacts on various species associated with nighttime lighting. We are recommending in section 4.5.3.3 that Aguirre LLC analyze if the Project could artificially induce biological aggregations, and provide empirical evidence showing how these potential aggregations could affect local fisheries and ecotourism activities.

Shading

General impacts from shading on benthic resources (e.g., corals and SAV) utilized by fishery species are discussed in section 4.5.2.4. Impacts of this habitat loss on fishery species may impact predator/prey interactions; however, we conclude these impacts would be permanent but minor. Aguirre

LLC is currently working with appropriate agencies to finalize its Benthic Resources Mitigation Plan to offset these habitat impacts.

Thermal Plume Discharge – Offshore Gasport

General impacts and mitigation information regarding thermal plume discharge from the Offshore GasPort are discussed in section 4.5.2.4. Fish have been well studied with regard to temperature tolerance and thermal limits in the field and in the laboratory. Thermal discharges can influence the spatial distribution of fish due to direct responses to altered temperature, effect on dissolved oxygen concentrations, and impacts on prey and habitat availability (EPA, 2014c). There is generally less temperature sensitivity in marine estuarine fish, which are often more tolerant than offshore fish, since estuarine fish are subject to regular environmental fluctuations (EPA, 2014c).

Impacts on fishery resources are expected to be permanent but minor, as mobile organisms would be able to move out of the zone of heated water.

Brine Water Discharge – Offshore Gasport

Operation of the Offshore GasPort would result in approximately 0.27 mgd (1,022 m^3/day) of brine water discharge from the desalination reverse osmosis unit. The salinity levels of brine discharges from the Offshore GasPort are estimated to be 64 to 70 ppt (64 to 70 mg/L), which is roughly double that of the supplied feed water. Changes in water salinity can influence aquatic organisms including fishery species in various ways including species development, reproduction, and population density (Danoun, 2007). Water salinity changes can additionally influence larval stages of fishery species. Impacts on ichthyoplankton are discussed in section 4.5.4.3. We expect the brine water plume to dissipate quickly due to local currents and vertical mixing near the Offshore GasPort. Prior to dispersion, mobile organisms would move out of the zone of increased salinity water. Permanent but minor impacts on fishery resources are expected from brine water discharges.

Anti-fouling Agents

To prevent macrofouling of the FSRU's raw water intake systems, the FSRU would utilize its on-board copper-aluminum anode MGPS. Organisms have different mechanisms by which they cope with and process copper. Generally, copper is actively regulated in fish, decapod crustaceans, and algae (Guardiola et al., 2012). General impact and mitigation information regarding the anti-fouling system are described in section 4.5.2.4.

The MGPS would release copper effluent at the FSRU within the EQB Class SB/SC water quality standard for copper discharge. Therefore, the resulting concentrations of copper effluent are not expected to cause adverse effects on fishery species. While, fishery species in the immediate vicinity of the outfall may be exposed to copper ions, these effects are anticipated to be negligible due the small zone of potential exposure and the ability for copper to bind to organic materials making it less bioavailable.

Seawater Intake

Operational uses of seawater have the potential to adversely affect fish populations via entrainment of larval stages (see section 4.5.4.3). The intake of water is anticipated to have negligible impact on juvenile and adult fish in the Project area, as they are all large enough to avoid entrainment and mobile enough to avoid the intake area.

Introduction of Exotic Species

LNG carriers in transit to and from the Offshore GasPort could import exotic species on their hulls and exterior equipment. The FSRU would undergo dry-dock maintenance about every 5 years. During scheduled dry-dock periods, PREPA may require Aguirre LLC to use a similar FSRU to meet contractual send-out rates. Therefore the new and/or returning FSRU could also import exotic species on its hull and exterior equipment. Operators of commercial vessels have a significant economic interest in maintaining underwater body hull platings in a clean condition. Fouling of bottom platings would result in increased fuel costs for voyages and could also reduce the vessel's maximum transit speed. To prevent fouling and the associated economic costs, operators aggressively and conscientiously apply hull plating preservation and maintenance programs.

LNG carriers would not discharge ballast water while unloading LNG at the Offshore GasPort. However, the commissioning of the new and/or returning FSRU associated with the dry-dock maintenance would likely require the discharge of ballast water from an offsite location. The USCG has developed responses to exotic/invasive organisms associated with foreign vessels. The USCG Office of Operating and Environmental Standards developed *Mandatory Practices for All Vessels with Ballast Tanks on All Waters of the United States*. The mandatory practices include requirements to rinse anchors and anchor chains during retrieval to remove organisms and sediments at their place of origin and remove fouling organisms from hull, piping, and tanks on a regular basis and dispose of any removed substances in accordance with local, state, and federal regulations.

Based on above descriptions of hull plating surface treatments, the mandatory practices required by the USCG, the lack of ballast water being discharged by the LNG carriers, and the infrequency of the ballast water discharges from the new and/or returning FSRUs, operation of the Project would not likely introduce exotic or invasive species into the Project area.

The lionfish is an invasive species found in the U.S. south Atlantic and Caribbean Sea including Puerto Rico. Lionfish are predatory in nature and have very few known natural predators. Lionfish are known to greatly reduce fish populations in reefs where they become established. Lionfish are habitat generalists and can be found in most marine habitat types found in warm waters of the tropics from 1 to 1,000 feet (0.3 m to 305 meters) deep including on hard bottom, mangrove, seagrass, as well as coral and artificial reefs. Operation of the Project is not expected to impact the already established lionfish populations in or surrounding the Project area.

4.6 THREATENED AND ENDANGERED SPECIES

Federal agencies are required by Section 7 of the ESA (19 USC § 1536(c)), as amended, to ensure that any actions authorized, funded, or carried out by the agency do not jeopardize the continued existence of a federally listed endangered or threatened species, or result in the destruction or adverse modification of the designated critical habitat of a federally listed species. The action agencies are required to consult with the FWS and/or NMFS to determine whether federally listed endangered or threatened species or designated critical habitat are found in the vicinity of a proposed project, and to determine the action's potential effects on those species or critical habitats. For actions involving major construction activities with the potential to affect listed species or designated critical habitat, the federal agency must prepare a Biological Assessment (BA) for those species that may be affected. The action agency must submit its BA to the FWS and/or NMFS and, if it is determined that the action would likely adversely affect a listed species, the federal agency must submit a request for formal consultation to comply with Section 7 of the ESA. In response, the FWS and/or NMFS would issue a Biological Opinion as to whether or not the federal action would likely jeopardize the continued existence of a listed species, or result in the destruction or adverse modification of designated critical habitat.

We reviewed the information submitted by Aguirre LLC, performed our own research, and consulted directly with the agencies regarding federally listed species in the Project area. Our analysis of the potential for Project-related impacts on these species and their designated critical habitats is discussed below.

FERC staff will continue to conduct its required Section 7 ESA consultation with the FWS and NMFS. However, since publication of the draft EIS, Aguirre LLC changed its design for the subsea pipeline in order to comply with the DOT pipeline standards in 49 CFR 192. As previously mentioned, the modified pipeline design includes burial of the offshore pipeline to at least below natural bottom in some locations and to 3 feet to the top of the pipeline in other locations, with the exception of approximately 1,700 feet (518 m) through the area across the Boca del Infierno pass where Aguirre LLC proposes to direct lay over the coral reef with protective concrete mats placed over the pipeline. While we agree with the changes in the pipeline design for compliance with the DOT regulations, we have concluded that the current pipeline design cross the Boca del Infierno pass is not environmentally acceptable. Therefore, we have not included our final BA in this EIS. Once the final pipeline route is determined (either an HDD under the Boca del Infierno pass or Alternative Route 6), then we will prepare our final BA for submittal to the FWS and NMFS. To ensure that impacts on ESA-listed species are addressed, **we recommend that:**

- **Aguirre LLC should not begin construction of the Project <u>until</u>:**

  a. we receive comments from the FWS and NMFS regarding the proposed action;

  b. we complete any necessary Section 7 with the FWS and NMFS, if required; and

  c. Aguirre LLC has received written notification from the Director of OEP that construction or use of mitigation may begin.

In addition to the ESA, the Commonwealth of Puerto Rico conserves species under the Regulation to Govern the Threatened and Endangered Species (Regulation No. 6766), and protects all corals under Law 147 of July 15, 1999. For purposes of this discussion, special status species of plants and animals include species known to occur in the coastal habitats of Puerto Rico found in or near the Project area that are listed by the federal government or Puerto Rico as endangered, threatened, or are proposed/candidates for listing. Other special status species such as those protected by the MBTA and the MMPA are discussed in section 4.5.3.

Special status species potentially occurring in the Project area are summarized in table 4.6-1 and discussed in section 4.6.1. Potential impacts on special status species and their designated critical habitat are discussed in section 4.6.2.

TABLE 4.6-1

Threatened and Endangered Species Potentially Occurring in the Aguirre Offshore GasPort Project Area

Common Name	Scientific Name	Federal Status	Puerto Rico Status	Areas Crossed by the Project Where Species May Occur [a]
Marine Mammals				
Antillean Manatee	*Trichechus manatus manatus*	E	E	Jobos Bay, Offshore
Blue whale	*Balaenoptera musculus*	E	NL	Offshore
Fin whale	*Balaenoptera physalus*	E	E	Offshore
Humpback whale	*Megaptera novaeangliae*	E	V	Offshore
Sei whale	*Balaenoptera borealis*	E	E	Offshore
Sperm whale	*Physeter macrocephalus*	E	E	Offshore
Reptiles				
Green sea turtle	*Chelonia mydas*	T, CH	E	Jobos Bay and Offshore
Hawksbill sea turtle	*Eretmochelys imbricate*	E, CH	E	Jobos Bay and Offshore
Leatherback sea turtle	*Dermochelys coriacea*	E, CH	E	Jobos Bay and Offshore
Loggerhead sea turtle	*Caretta caretta*	T	NL	Jobos Bay and Offshore
Puerto Rican Boa	*Epicrates inornatus*	E	V	Uplands
Birds				
Brown Pelican	*Pelecanus occidentalis*	DL	E	Jobos Bay and Offshore
Piping plover	*Charadrius melodus*	T	CE	Jobos Bay
Puerto Rican broad-winged hawk	*Buteo platypterus brunnescens*	E	CE	Uplands
Puerto Rican nightjar	*Caprimulgus noctitherus*	E	E	Uplands
Puerto Rican plain pigeon	*Columba inornata wetmorei*	E	E	Uplands
Puerto Rican sharp-shinned hawk	*Accipiter striatus venator*	E	CE	Uplands
Snowy plover	*Charadrius alexandrinus*	NL [b]	CE	Jobos Bay
Yellow-shouldered blackbird	*Agelaius xanthomus*	E	E	Uplands
Rufa Red Knot	*Calidris canutus rufa*	T	NL	Jobos Bay and Offshore
Amphibians				
Golden Coqui	*Eleutherodactylus jasper*	T, CH	CE	Uplands
Fishes				
Dwarf seahorse	*Hippocampus zosterae*	C	V [c]	Jobos Bay
Goliath grouper	*Epinephelus itajara*	NL	CE	Jobos Bay and Offshore
Great hammerhead shark	*Sphyrna mokarran*	C	NL	Jobos Bay and Offshore
Nassau grouper	*Epinephelus striatus*	PT	E	Jobos Bay and Offshore
Scalloped hammerhead shark	*Sphyrna lewini*	T	NL	Jobos Bay and Offshore

TABLE 4.6-1 (cont'd)

Threatened and Endangered Species Potentially Occurring in the Aguirre Offshore GasPort Project Area

Common Name	Scientific Name	Federal Status	Puerto Rico Status	Areas Crossed by the Project Where Species May Occur [a]
Invertebrates				
Boulder star coral	*Orbicella annularis*	T	NL[d]	Jobos Bay and Offshore
Elkhorn coral	*Acropora palmata*	T, CH	NL[d]	Jobos Bay and Offshore
Elliptical star coral	*Dichocoenia stokesii*	NL	NL[d]	Jobos Bay and Offshore
Lamarck's sheet coral	*Agaricia lamarcki*	NL	NL[d]	Jobos Bay and Offshore
Mountainous star coral	*Orbicella faveolata*	T	NL[d]	Jobos Bay and Offshore
Pillar coral	*Dendrogyra cylindrus*	T	NL[d]	Jobos Bay and Offshore
Queen conch	*Strombus gigas*	C	NL	Jobos Bay and Offshore
Rough cactus coral	*Mycetophyllia ferox*	T	NL[d]	Jobos Bay and Offshore
Staghorn coral	*Acropora cervicornis*	T, CH	NL[d]	Jobos Bay and Offshore
Star coral	*Orbicella franksi*	T	NL[d]	Jobos Bay and Offshore
Plants				
Erubia	*Solanum drymophilum*	E	E	Uplands
Cobana Negra	*Stahlia monosperma*	T	V	Uplands
Palo de ramon	*Banara vanderbiltii*	E	CE	Uplands
Puerto Rico manjack	*Varronia rupicola*	T	E	Uplands
Island brittleleaf	*Gonocalyx concolor*	E	NL	Uplands

Sources: NMFS, FWS, Puerto Rico Department of Natural and Environmental Resources.

[a] Offshore refers to the area south of Jobos Bay (beyond the barrier islands).

[b] Only western U.S. population listed as threatened.

[c] Puerto Rico lists all seahorses as vulnerable.

[d] Coral species are not listed in the Commonwealth of Puerto Rico's Regulation to Govern the Threatened and Endangered Species (Regulation No. 6766); however all corals are protected under Law 147 of July 15, 1999.

Notes: E = Endangered, T = Threatened, PE= Proposed for Endangered Status, PT = Proposed for Threatened Status, CH = Critical Habitat, C = Candidate, DL = Delisted, CE = Critically Endangered, V = Vulnerable, NL = Not Listed

Additional threatened and endangered species found in the region are listed in table 4.6-2. Due to the distance of their primary habitat from the Project area, the Project is expected to have *no effect* on these species. Thus, they are not discussed further in this section. Our determination of effects for the remaining species is summarized in section 4.6.3.

TABLE 4.6-2

Justification for Determinations of No Effect on Federally Listed Species for the Aguirre Offshore GasPort Project Area

Species Name	Habitat Description and Project Assessment
Reptiles	
Puerto Rican boa	Species occurs in moist and wet forest, woodland and shrub land mangrove, mature dry forest, and dry forest near waterbodies. No potential habitat is present in the Project Area.
Birds	
Piping plover	Species occurs along coastal beaches, mudflats, and tidal flats. Is considered an uncommon migrant in Puerto Rico and has not been reported to occur within the JBNERR. The FWS stated there would be no effects on this species (FWS, 2014a).
Puerto Rican broad-winged hawk	Species occurs in subtropical wet forests and subtropical rain forests habitat types. May occur as a transient in the vicinity of the Project, but is not expected to utilize the Project area for foraging, nesting, or breeding.
Puerto Rican nightjar	Species occurs in forested areas in southern Puerto Rico. The Puerto Rican nightjar was documented approximately 3 miles (4.8 km) northeast of the Project area, where the closest suitable habitat is located. However, there is no suitable habitat in the Project area.
Puerto Rican plain pigeon	Habitat generalist; nest, forage, and roost in trees near roads, breed in mature forests near water bodies. No potential habitat is present in the Project Area.
Puerto Rican sharp-shinned hawk	Species occurs in subtropical wet forests habitat types. May occur as a transient in the vicinity of the Project, but is not expected to utilize the Project area for foraging, nesting, or breeding.
Rufa red knot	Species occurs along coastal beaches, mudflats, and tidal flats. Is considered an uncommon migrant in Puerto Rico and has not been reported to occur within the JBNERR. The FWS (2014a) stated there would be no effects on this species.
Amphibians	
Golden Coqui	Species occurs in forested mountains over 2,300 feet in elevation. No potential habitat is present in the Project Area.
Plants	
Erubia	Habitat includes evergreen forests on volcanic soils at elevations above 1,000 feet. Population limited to Tetas de Cayey in the Sierra de Cayey in Central Puerto Rico. No potential habitat is present in the Project Area.
Cobana Negra	Species habitat includes uplands near brackish and seasonally flooded mangrove wetlands, mainly in northeast and southwest Puerto Rico. No potential habitat is present in the Project Area.
Palo de ramon	Species habitat includes northwest limestone hills and central mountains of Puerto Rico in elevations above 300 feet. No potential habitat is present in the Project Area.
Puerto Rico manjack	Habitat includes areas with remnant native shrubland and scrubland forest on limestone substrate within coastal subtropical dry forest life zone. Seven populations occur in Puerto Rico but none are within Salinas or Guayama. Seven units of critical habitat have been designated for the species; however, no critical habitat occurs within the Project area. The closest unit of critical habitat (Unit 4) occurs 30 miles west of the Project in Peñuelas and Ponce. The upland area of the Project has been disturbed by development; there is no potential habitat for the Puerto Rico manjack present in the Project area.
Island brittleleaf	A small shrub that grows as an epiphyte on dead and live trees and along the forest floor in wet high-elevation areas (over 620 meters). There are three known populations within the Carite Commonwealth Forest of east-central Puerto Rico. Two units of designated critical habitat occur 15 miles inland from the Project area. No potential habitat is present in the Project area.

Sources: FWS, 2010, 2011a, 2014a

4.6.1 Description of Potentially Affected Species

4.6.1.1 Marine Mammals

Antillean Manatee

The manatee is an herbivorous marine mammal most commonly found in coastal estuaries and rivers. There are three species worldwide, but only the West Indian manatee (*Trichechus manatus*) can be found in U.S. waters. The West Indian manatee is divided into two subspecies: the Antillean manatee (*Trichechus manatus manatus*) and the Florida manatee (*Trichechus manatus latirostris*). The West Indian manatee and its subspecies are listed as endangered under the ESA and depleted under the MMPA Act of 1972. Global protection of the Antillean manatee is provided by the International Union for Conservation of Nature, which lists it as endangered (Self-Sullivan and Mignucci-Giannoni, 2008).

The Florida manatee is restricted to the coast of Florida during the winter months then travels north along the Atlantic coast (highest abundance in Georgia; as far north as Rhode Island) and west along the Gulf coast states (to Texas) from March to November, (Deutsch et al., 2008). The Florida manatee is not expected to occur in the Project area.

Antillean manatees inhabit coastal areas of eastern Mexico and Central America, northern and eastern South America, and in the Greater Antilles (FWS, 2009b). The Antillean manatee population in Puerto Rico has been recorded in protected areas such as cays, bays, and shallow seagrass beds east of San Juan, and along the east, south, and southwest coasts where freshwater sources are available. However, Antillean manatees are most abundant and consistently found along the southern and eastern coasts, specifically in the Jobos Bay area and Roosevelt Roads Naval Station, Ceiba, which is approximately 45 miles (72 km) northeast of the Project area (FWS, 2014b; Field et al., 2003).

In 2008, the International Union for Conservation of Nature estimated the Antillean manatee subspecies population to be approximately 4,100 individuals. This population is projected to decline by 20 percent over the next 40 years (Deutsch et al., 2008). The decline is predicted to occur as a result of non-effective conservation actions from current and projected anthropogenic threats (Self-Sullivan and Mignucci-Giannoni, 2008). In 2009, the population in Puerto Rico was determined to be either stable or slightly increasing (FWS, 2014b). Jobos Bay has been documented as having the second largest Antillean manatee population in Puerto Rico (Field et al., 2003). The FWS estimates that the Antillean manatee population in Puerto Rico consists of a minimum of 142 individuals, to a maximum of 618 individuals (FWS, 2014b; Drew et al., 2012).

Manatee preferred habitat consists of protected shallow waters, some fresh water sources, and seagrass beds. They are known to congregate near warm water outflows associated with anthropogenic sources. Manatees feed on seagrasses and occasionally on other marine plants including green algae, mangroves, and water hyacinth (FWS, 2007b). Manatees tagged around Puerto Rico showed both resident and transient patterns; some individuals were documented to move very little within the estuary in which they were tagged, while others traveled among estuaries along the southern coast (FWS, 2007b). Breeding and calving occurs throughout the year and individuals live to 50 or 60 years of age (FWS, 1986).

Three Antillean manatees were observed over seagrass beds near Boca del Infierno pass during Aguirre LLC's marine mammal surveys in April/May 2012 (Tetra Tech, 2013d). One Antillean manatee was observed offshore of Boca del Infierno pass during Aguirre LLC's coral mapping in November 2013 (Tetra Tech, 2014d).

Whales

Whales are long-lived marine mammals that inhabit the world's oceans. Many species migrate extremely long distances to take advantage of seasonal food resources or calm wintering grounds for rearing young. They can be divided into two main groups: toothed whales and baleen whales. Feeding morphology and prey are the major differences between these groups. Commonly, whales are found to utilize warm tropical waters during winter months when the polar seas are cold, ice covered, and food-poor, though some species will stay in these regions year-round.

The sperm whale (*Physeter macrocephalus*) is a toothed whale that inhabits the deeper waters of the world's oceans throughout the year. They feed primarily on squid and other deep sea creatures. Migrations are not as distinct as other species and thought to primarily follow food resources (NMFS, 2010b). The Atlantic population is considered a separate stock from the Pacific and Indian Ocean stocks. Additionally, the Gulf of Mexico stock has been petitioned for separate listing as a Distinct Population Segment under the ESA due to isolation in the northern Gulf of Mexico and the unique threats in that area such as oil and gas development and habitat degradation (WildEarth Guardians, 2011). Due to the complex bathymetry around Puerto Rico and the Caribbean Sea, sperm whales could utilize the offshore Project area as feeding grounds.

The humpback whale (*Megaptera novaeangliae*) is a baleen whale that is distributed throughout the world's oceans. They generally spend winter months in lower temperate and tropical waters then migrate northward and southward in summer months to feed in areas of high productivity (i.e., high latitudes). Within the Caribbean and western Atlantic, humpbacks are commonly found south of the Bahamas and along the Dominican Republic, with some activity on the western side of Puerto Rico and down the Lesser Antilles (NMFS, 1991). Calving occurs primarily during the winter months, and the only breeding ground in U.S. waters is in Puerto Rico (NMFS, 1991). A limited amount of research has been conducted off Puerto Rico to determine the abundance, movement, and habitat use of humpback whales. Research was conducted each winter from 2011 through 2014 to collect opportunistic data for marine fauna in the form of photographs of whales (including humpback whales), dolphins, manatees, and sea turtles. Unpublished data (Mackay, 2014) submitted during the draft EIS public comment period concluded that:

- humpback whales are found seasonally and predictably in the waters surrounding Puerto Rico, including the south coast, from approximately January 1 through May 1;
- the peak season is roughly the middle of February to the middle of March;
- waters off the south coast of Puerto Rico are being used by humpback whales as a gateway between their northern habitats and the Lesser Antilles each winter;
- waters around Puerto Rico are used as humpback whale nursery areas and for reproductive behaviors near shore and offshore; and
- competitive breeding groups of humpback whales and humpback whale singers (males seeking breeding opportunities) are spotted in the waters off Puerto Rico each winter.

Other baleen whales, including the fin whale (*Balaenoptera physalus*), sei whale (*Balaenoptera borealis*), and blue whale (*Balaenoptera musculus*), are listed by NMFS as occurring within the southeast region (generally, the Gulf of Mexico and U.S. territories in the Caribbean). These whales are not commonly found around Puerto Rico, but could utilize the area during migrations or other movements. Feeding is not expected in or around Puerto Rico as these species usually feed on zooplankton and small fish aggregations during summer months in the north Atlantic (NMFS, 1998, 2010a, 2011b). Calving and breeding grounds have not been identified for these species in Puerto Rico.

No whales were observed during the marine mammal surveys conducted by Aguirre LLC for the Project (Tetra Tech, 2013d). However, the surveys only occurred in late April through early May, missing the peak season of the middle of February through March.

4.6.1.2 Sea Turtles

Sea turtles are found throughout the tropical and subtropical seas of the world. All species are listed as threatened or endangered under the ESA. Trade of sea turtles is restricted by the Convention on International Trade in Endangered Species; however, not all countries have ceased to harvest these species. The major threats to sea turtle populations are overharvesting, fisheries by-catch, disease, pollution, and coastal development of nesting beaches. Four sea turtle species could occur in the water proximate to the Project area: the green (*Chelonia mydas*), the hawksbill (*Eretmochelys imbricate*), the leatherback (*Dermochelys coriacea*), and the loggerhead (*Caretta caretta*).

Sea turtles are highly migratory and will transit significant distances between foraging and nesting locations. Natal site fidelity is a major influence for all species, and breeding-associated migration occurs every 1 to 4 years depending on the species (Lutz et al., 2003). Many tagged individuals follow circumglobal routes between nesting and foraging locations, which can be hundreds to thousands of miles apart (Luschi et al., 2003).

Sea turtles utilize sandy beaches to lay their eggs. The age at which sea turtles reach sexual maturity varies considerably between and within species, ranging from as few as several years to as long as two decades (Milton and Shigenaka, 2003). They breed at sea, and the females return to their natal beaches to lay eggs in the sand. Females typically nest 1 to 10 times during the nesting season, again depending upon the species, with clutch sizes of 80 to 150 eggs. About 2 months after being laid, eggs hatch, and the hatchlings immediately enter the sea. Once at sea the males rarely, if ever, return to land.

Developmentally, the green, hawksbill, and loggerhead sea turtles follow a pattern of oceanic juvenile stages followed by utilization of the neritic zone (i.e., coastal waters overlying the continental shelf) in later development stages (Bolten, 2003). Conversely, the leatherback shows the strongest pattern of pelagic habitat usage throughout its life. This pattern affects where these turtles feed and what species they forage on (Bjorndal, 1997; Bolten, 2003).

Five green sea turtles were sighted in the Project area during the marine mammal and sea turtle survey completed by Aguirre LLC (Tetra Tech, 2013d). The remaining species were not observed; however, the surveys only occurred in late April through early May, which is a limited window for observing these wide-ranging and highly mobile animals. Two loggerhead sea turtles were observed offshore of Boca del Infierno pass during Aguirre LLC's coral mapping in November 2013 (Tetra Tech, 2014d).

Hawksbill Sea Turtle

The hawksbill sea turtle is widely distributed throughout the tropical waters of the world's oceans. They have been shown to migrate significant distances between foraging and nesting sites (Plotkin, 2003). Hawksbills are commonly found in the waters around Puerto Rico and associated islands and nest on a number of beaches (NMFS and FWS, 2007b) both in Puerto Rico and throughout the Caribbean with the most important nesting sites found on the Yucatan Peninsula (NMFS and FWS, 1993). The estimated number of adult hawksbills living in the Caribbean in 2003 was 27,000 (NOAA, 2014).

Hawksbill turtles are known to have strong site fidelity for their nesting beaches and are capable of returning to specific beach areas every 2 to 3 years to nest. In Puerto Rico, hawksbills are known to nest on the beaches of Humacao, Isla Culebra, Isla Caja de Muertos, and Islas Mona and Monita (NMFS and FWS, 2007b). Isla Caja de Muertos is approximately 20 miles (32 km) west of the Project area, while Humacao is approximately 30 miles (48 km) east, suggesting turtles could forage in and/or migrate through the Project area frequently. The Isla Mona and Isla Monita habitats, which are located over 100 miles (161 km) west of the Project area, have been designated as critical habitat for the hawksbill sea turtle since 1998 (63 Federal Register [FR] 46693). Peak nesting season on Islas Mona is from August to October. Recent monitoring has concluded that each year about 500 to 1,000 hawksbill nests are laid on Mona Island (NOAA, 2014). Hawksbills nest on average 3 to 5 times per season (NOAA, 2014); therefore, there is an estimated 100 to 333 female hawksbills that nest on Mona Island annually. Young hawksbills are found foraging in association with *Sargassum* mats, and after leaving the pelagic stage they commonly forage over coral reefs and hard bottom substrate. They can also be found over seagrass and in bays fringed with mangroves (Bjorndal, 1997). In the Caribbean, sponges are the primary, and in many cases the exclusive, food source (Bjorndal, 1997).

Leatherback Sea Turtle

The leatherback sea turtle is the largest and most pelagic of the sea turtles. This species occurs globally, and ranges farther north and south than the other species, likely due to their ability to maintain warmer body temperatures (NMFS and FWS, 2007c). The largest breeding populations are found on the Pacific coast of Mexico. In the Caribbean, French Guiana supports the largest population followed by a number of other countries, while the U.S. Caribbean supports relatively few nesting colonies (NMFS and FWS, 1992). However, the number of leatherback nests has been increasing over the past 30 years, with at least 469 nests recorded each year from 2000 to 2005 in Puerto Rico. Important nesting areas in Puerto Rico are Fajardo and Isla Culebra, located approximately 40 to 60 miles (64 to 97 km) to the northeast of the Project, respectively. The nesting sites at Cuelbra have been in steady decline since 2004, with only five females nesting on the island in 2012. Evidence suggests that this is not representative of a loss of breeding population but rather a shift in nesting site preference, which is still being studied (NMFS and FWS, 2013). Although considered omnivorous (feeding on sea urchins, crustaceans, fish, and floating seaweed), leatherbacks feed principally on soft foods such as cnidarians (medusae, siphonophores) and tunicates (salps, pyrosomas) (Bjorndal, 1997; NMFS and FWS, 1992). Leatherbacks may also forage nocturnally at depth on siphonophores and salps in the deep scattering layer (NMFS and FWS, 1992).

Green Sea Turtle

The green sea turtle is found throughout the world's oceans where temperatures remain above 68 °F (20 °C). There are three breeding populations; the global population is considered threatened while the two other breeding populations (Florida and Pacific Mexico) are considered endangered (NMFS and FWS, 2007a). While there are no major green sea turtle nesting sites in Puerto Rico or the surrounding islands, the coastal waters are likely common foraging grounds for both the global and Florida-breeding populations (Lutz et al., 2003). Critical habitat for the green sea turtle is located on Culebra Island, Puerto Rico, which is over 60 miles (97 km) northeast of the Project area. Green sea turtles can exhibit high site fidelity with respect to both nesting and feeding, which can lead to common migratory routes (Luschi et al., 2003). However, some individuality and variation has been documented. As one of the more coastal species of sea turtle, green turtles forage primarily on benthic organisms. Food sources include seagrasses and algae as well as animal food items including mollusks, crustaceans, bryozoans, sponges, jellyfish, polychaetes, echinoderms, fish, and fish eggs (Bjorndal, 1997; NMFS and FWS, 1991). In the Caribbean, the primary seagrass food source is turtle grass (Bjorndal, 1997), which is one of the dominant seagrass species in Jobos Bay.

Loggerhead Sea Turtle

The loggerhead sea turtle is most commonly found over the continental shelves around the world and may be present in the Project area. Loggerheads can migrate significant distances between foraging areas, breeding areas, and nesting locations (Plotkin, 2003). Loggerheads nest around the Gulf of Mexico basin, including Cuba, and the southeastern coast of the mainland United States (NMFS and FWS, 2008). Nesting is no longer observed along the rest of the Greater Antilles, including Puerto Rico (NMFS and FWS, 2007d). Loggerhead sea turtles are omnivorous, feeding on a variety of benthic prey such as shellfish, crabs, barnacles, oysters, jellyfish, squid, and sea urchins; and occasionally on fish, algae, and seaweed (Lutz and Musick, 1997; NMFS and FWS, 2008). As with green sea turtles, loggerheads move from pelagic foraging preferences to more benthic-associated feeding at a certain age (Bjorndal, 1997). They are known to forage over hard and soft benthic substrate. During their pelagic stage, they are often found associated with macroalgae mats.

4.6.1.3 Birds

Snowy Plover

Plovers are migratory shore birds, usually wintering in warmer climates and migrating north during the summer months to breed. During the winter these birds forage on coastal beaches, mudflats, and tidal flats for benthic epifaunal and infaunal prey. The southeastern subspecies of snowy plover (*Charadrius alexandrinus tenuirostris*) occurs in Puerto Rico (76 FR 55638-55641). This subspecies includes Gulf of Mexico and Caribbean populations and accounts for around 1,500 individuals, of which 27 pairs reside and breed in Puerto Rico (Morrison et al., 2006). Although this subspecies of snowy plover is not federally listed under the ESA, it is protected under the MBTA and is listed as critically endangered by the Commonwealth of Puerto Rico. In Puerto Rico, nesting begins in January on sandy beaches and the breeding season can last from March to mid-summer.

Brown Pelican

The brown pelican (*Pelecanus occidentalis*) was delisted from the ESA in 2009 (74 FR 59444-59472); however, Puerto Rico lists this bird as endangered. Brown pelicans reside in colonies year-round in Puerto Rico and nest irregularly from late fall through June, but some undertake migrations north to breed. They feed by diving into the water; their diet consists of primarily fish but occasionally other marine organisms. This species roosts after diving to dry plumage and to conserve energy (FWS, 2007a); manmade habitats such as piers, docks, and buoys are commonly utilized for this purpose. Pelicans nest in vegetated areas such as trees, shrubs, and mangroves. The breeding population in Puerto Rico has been estimated to be constant at 150 to 250 breeding pairs over a series of surveys (FWS, 2009a). Brown pelicans are commonly seen in the JBNERR, and likely reside and feed in the waters within the bay and the coastal ocean surrounding it.

Yellow-Shouldered Black Bird

The yellow-shouldered black bird (*Agelaius xanthomus*) is endemic to Puerto Rico and utilizes mudflats and saltflats, black mangrove forests, and offshore red mangrove cays for nesting habitat. Nests are usually built in clusters low in mangrove trees or in large deciduous trees near mangroves. Their breeding season is commonly April to August but varies to some degree as it coincides with the rainy season (FWS, 2011b); it can occur as early as February and as late as November. Although the yellow-shouldered black bird is non-migratory, portions of the population move inland from coastal areas during the non-breeding season to feed (FWS, 2011b). This species feeds predominantly on insects, seeds, and nectar, but has been documented consuming cattle ration, dog food, fruit, cooked rice, and granulated sugar within bird feeders and around domestic animals. Yellow-shouldered black birds have been observed within the JBNERR where mangrove forests and cays may provide adequate nesting habitat (Field et al., 2003). Critical habitat for this species is designated in Puerto Rico; however, the closest critical habitat is over 40 miles (64 km) west of the Project area (42 FR 47842). Although yellow-shouldered black birds prefer to nest in black mangrove forests, they have been documented utilizing urban areas for nesting. In 2000, several yellow-shouldered black bird nests were observed at the PREPA facilities in Aguirre and Guayama (FWS, 2011b). Therefore, it is possible that this species could be found within the onshore portion of the Project area.

4.6.1.4 Fishes

Goliath Grouper

The goliath grouper (*Epinephelus itajara*) is the largest of the Atlantic groupers, growing up to about 8 feet (2.4 m) in length and weighing up to about 700 lbs (317 kilograms [kg]). Harvesting this species is prohibited in Puerto Rico territorial waters and the EEZ. Their larvae are pelagic, and juveniles are commonly found in mangroves and seagrass beds. Adults tend to prefer areas of high relief, presumably for shelter and protection, and they can be found on manmade structures in addition to rock crevices and overhangs (NMFS, 2006). Adults are sedentary and prefer shallower habitats up to about 164 feet (50 m) deep. They feed on a variety of prey items, including crustaceans such as spiny lobster, and opportunistically on other passing prey. Goliath groupers are dispersal spawners; the timing of spawning is regional and thought to peak in July and August in the Caribbean (NMFS, 2006). They may form spawning aggregations, but this is not well documented. Mangroves make up some of the barrier islands that form Jobos Bay in addition to extensive mangrove forest of the JBNERR. As a result, it is likely that this species could be found within the Project area.

Nassau Grouper

The Nassau grouper (*Epinephelus striatus*) is a reef fish that is proposed as threatened for listing under the ESA (79 FR 51929). Nassau groupers are found throughout the West Indies, Bahamas, and southern Gulf of Mexico. They grow to about 4 feet (1.2 m) in length and can weigh up to 44 lbs (20 kg) (Jory and Iversen, 1989). They prefer habitat that is high in relief, such as coral reefs and rocky bottoms. Nassau groupers can be found from shallow waters to waters more than 295 feet (90 m) in depth. Depth preferences appear to be associated with size, with larger animals tending to occupy deeper habitats (Jory and Iversen, 1989). Nassau groupers are protogynous hermaphrodites and can change from females to males when they reach a size between about 1 to 2.6 feet (0.3 to 0.8 m) in length (Jory and Iversen, 1989). They spawn in the winter, and form large spawning aggregations during full moons. Eggs and larvae are planktonic and can be dispersed on coastal currents. The juveniles utilize seagrass beds during development prior to maturity.

In Puerto Rico, the species is protected and harvest is prohibited. There are few reports of spawning aggregations around the island (Aguilar-Perera et al., 2006). Groupers are carnivorous, feeding on crustaceans and other small fish. Their diet may be ontogenetic, consisting of primarily crustaceans when they are smaller and found in seagrass beds, but switching to primarily fish prey as they mature and move to coral reef habitats (Eggleston et al., 1998). This species was not observed during the benthic habitat survey conducted by Aguirre LLC but has the potential to occur in the Project area.

Sharks

The scalloped hammerhead shark is a threatened species under the ESA (79 FR 38214). The great hammerhead shark is currently a candidate for listing. Both species have the potential to occur in the Project area. An additional shark species found in the region, the dusky shark, is listed as a Species of Concern by NMFS. This species is discussed in section 4.5.5.1.

The major threat to great hammerhead and scalloped hammerhead sharks is overfishing, mainly in the shark fin trade but also as a result of by-catch in other fisheries. Both species can be found throughout the tropical and warmer temperate oceans of the world. In tagging studies, scalloped hammerhead sharks have been shown to congregate in core areas and have site fidelity, but time spent away from original tagging locations varies widely (Miller et al., 2013). The great hammerhead sharks are more solitary and are generally found over continental shelves, island terraces, and in passes and lagoons of coral atolls in water depths ranging from 3 to over 262 feet (1 to over 80 m) (Shark Research Institute, 2005). The diet of both species consists of a variety of prey species, ranging from fish and crustaceans to gelatinous organisms. The western Atlantic population of the scalloped hammerhead shark has been shown to grow more slowly than other population segments (Miller et al., 2013). After hammerhead individuals mature to a certain size, they are capable of reproduction and give birth to live pups approximately once every 2 years. Great hammerheads, unlike most other shark species, have been observed to mate in waters near the surface (Shark Research Institute, 2005; Florida Museum of Natural History, Undated). Great hammerheads were witnessed in the Bahamas to have risen from a depth of 70 feet (21 m), spiraling slowly around each other and copulating at the surface (Shark Research Institute, 2005).

Seahorses

The dwarf seahorse (*Hippocampus zosterae*) is a reef fish that is a candidate species for listing under the ESA. This species was recently petitioned for listing as an endangered species due to loss of habitat, commercial collection, and endangerment due to the 2010 BP Deepwater Horizon oil spill in the Gulf of Mexico (Center for Biological Diversity, 2011). This species occurs along the Atlantic coast of Florida and throughout the Gulf of Mexico and the Caribbean, inhabiting shallow seagrass beds in these warm water areas. They feed on crustacean prey both pelagic and benthic. This small species, the smallest seahorse in U.S. waters, lives about 1 year and reaches sexual maturity at about 3 months of age (Foster and Vincent, 2004). They form monogamous pairs and breed throughout the majority of the year, from February through November, as frequently as twice per month (Foster and Vincent, 2004). As with all seahorses, young are born alive after incubating in the male's pouch. Dwarf seahorses were not observed during the benthic habitat survey conducted by Aguirre LLC but have the potential to occur in the Project area. Other species of seahorses that may be present in the Project area include *H. erectus* and *H. reidi* (Foster and Vincent, 2004), which are both listed as vulnerable in Puerto Rico.

4.6.1.5 Invertebrates

Corals

Coral reefs are structurally and biologically complex ecosystems. The physical structure of reefs is provided primarily by scleractinian (stony) corals. These species grow in clear coastal waters and provide many services to the other species residing among them. In addition to providing structural habitat, they also produce energy via photosynthesis, recycle nutrients, deposit calcium carbonate, and produce sand (Brainard et al., 2011).

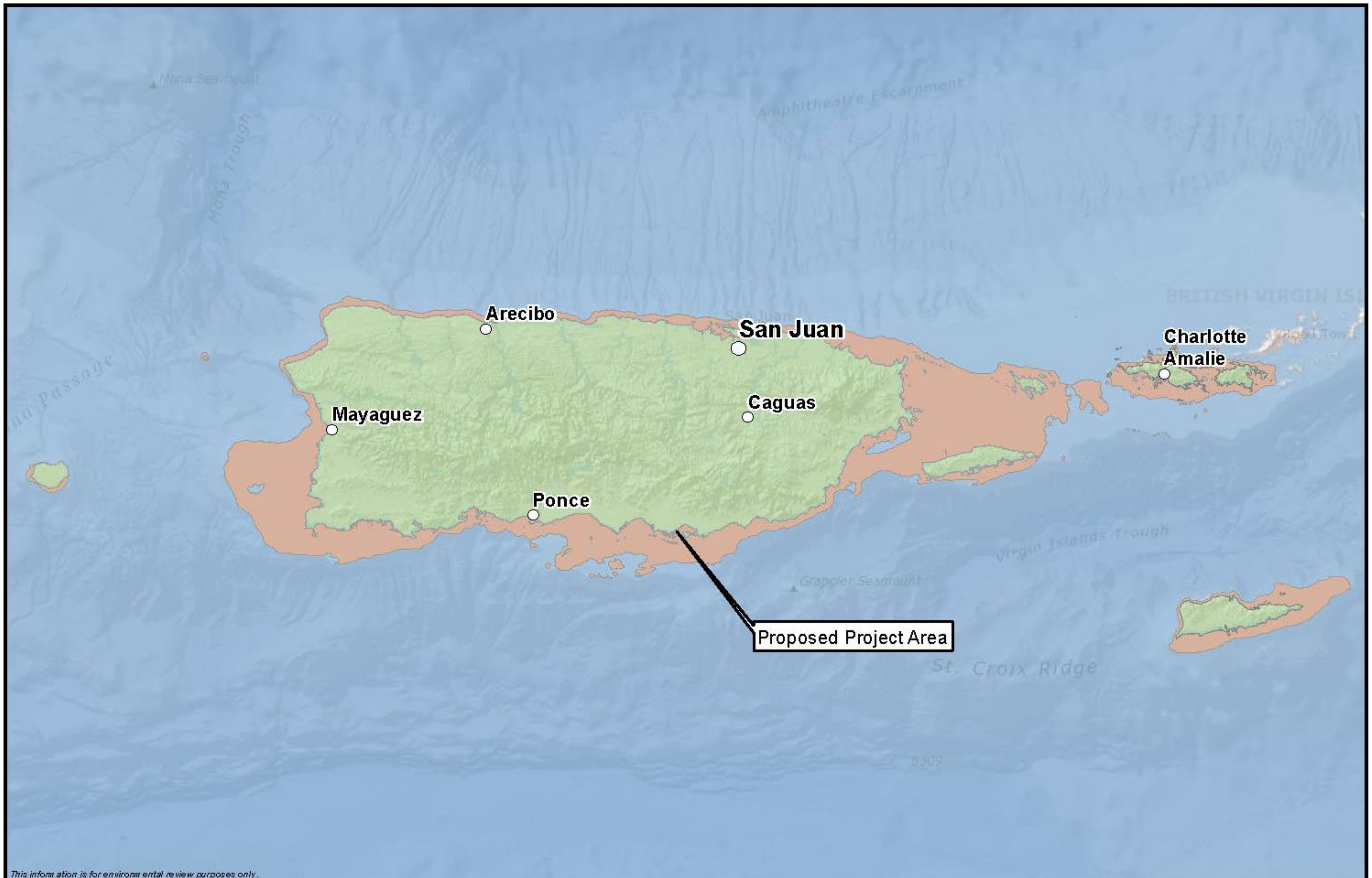
Most corals are clonal species, which means they can grow by adding additional polyps. Other than growth, a colony can expand through fragmentation where detached pieces can reattach to nearby substrate and continue growing (Acropora Biological Review Team [Acropora BRT], 2005). Additionally, corals can also reproduce sexually, most commonly by broadcast spawning or brooding. Both growth mechanisms are important to survival as asexual reproduction allows for quick growth but may leave the colony susceptible to disease and other impacts due to the lack of genetic diversity. Additional discussion of coral sexual reproduction and coral larvae in the Project area can be found in section 4.5.4.2.

Corals can feed both autotrophically (i.e., by synthesizing their own food) and heterotrophically (i.e., by feeding on other organisms). During daylight hours, coral colonies are provided with carbon through the photosynthetic process employed by symbiotic algae that live within the corals. Additionally, corals feed directly on zooplankton filtered from the water column, which provide additional nutrients not acquired through photosynthesis (Brainard et al., 2011).

Coral reefs are sensitive to environmental changes. While able to withstand some fluctuation, the survival of individual species and the reef ecosystem on the whole is affected by a number of variables. Temperature is an important variable to the survival of coral. Increases in temperature can lead to bleaching events. An increase in temperature as little as 2 to 4 °F (1.1 to 2.2 °C) can put a population at risk (Acropora BRT 2005), and an increase in 5 to 7 °F (2.8 to 3.9 °C) can cause thermal stress leading to death (Brainard et al., 2011). This is most important during warmer summer months and during El Nino-Southern Oscillation periods when temperatures are already elevated. However, human use can also raise water temperature in localized patches. Other effects of direct human use, such as anchoring, can cause major destruction (García-Sais et al., 2008).

Physical effects to coral are well documented in the general Project region. Hurricanes can cause high-energy seas that affect the shallowest reefs and can also penetrate to deeper reefs (García-Sais et al., 2008). Other effects from storms, such as increased stormwater runoff from land can have additional implications. Stormwater runoff can increase the sediment load in the waters over the reefs, reducing light availability (García-Sais et al., 2008). *Acropora* species are particularly susceptible to loss of light and have been shown to be one of the most sensitive reef species (Acropora BRT, 2005).

Historically, elkhorn (*Acropora palmata*) and staghorn (*A. cervicornis*) corals were found throughout the shallow waters of the Caribbean sea, the southern Gulf of Mexico, and the central western Atlantic (Acropora BRT, 2005). However, in the early 1980s a major decline occurred, reducing populations to less than 97 percent of historic population levels. Since this decline, there has been little appreciable recovery, and additional loss of established colonies was recorded throughout the late 1990s. Acropora BRT (2005) assessed the status of these species and concluded there was no immediate threat of extinction but that there could be in the coming future; thus, these species were proposed for threatened status under the ESA in May 2005 (70 FR 24359). Approved a year later (71 FR 26852), they remained at the threatened level until they were proposed for the elevated listing of endangered in December 2012 (77 FR 73219). At that time critical habitat was designated (73 FR 72210), which includes all waters less than 98 feet (30 m) deep around Puerto Rico and associated islands. This critical habitat extends from the coast approximately 2.8 miles (4.8 km) offshore of Barca Cay, which is approximately 2.2 miles (3.5 km) south of the Project area. Elkhorn and staghorn coral critical habitat can be seen on figure 4.6.1-1 as the pink shaded areas surrounding Puerto Rico and the U.S. Virgin Islands. A final rule posted by NMFS in August 2014 determined that elkhorn and staghorn corals still warrant listing as threatened, and they were not elevated to listing of endangered (79 FR 53853).



Acropora Critical Habitat

1:1,600,000

0 10 20 Miles

0 15 30 Kilometers

N

Figure 4.6.1-1
Elkhorn and Staghorn Coral Critical Habitat
Aguirre Offshore GasPort Project

In August 2014, NMFS posted a final rule (79 FR 53853) to list five stony coral species as threatened, including boulder star coral (*Orbicella annularis*), mountainous star coral (*O. faveolata*), star coral (*O. franksi*), pillar coral (*Dendrogyra cylindrus*), and rough cactus coral (*Mycetophyllia ferox*). Two species, Lamarck's sheet coral (*Agaricia lamarcki*) and elliptical star coral (*Dichocoenia stokesii*), were proposed for threatened status; however, the August 2014 NMFS rule found that these species did not warrant listing as threatened status under the ESA, and were subsequently removed from federal protection. All of these species were found within the proposed Project area during the benthic surveys conducted by Aguirre LLC. These benthic surveys also identified 24 non-federally listed coral species. As discussed above, the Commonwealth of Puerto Rico protects all corals under Law 147 of July 15, 1999. Impacts on these non-listed coral species would be similar to those discussed below. However, as outlined in Aguirre LLC's draft Benthic Resources Mitigation Plan, prior to construction all federally-listed and non-listed coral species would be removed from the construction corridor in the Boca del Infierno pass and only federally-listed coral species would be removed from under the Offshore Gasport.

Staghorn coral is common in waters up to 66 feet (20 m) deep with colonies forming less dense structures in deeper habitat (Acropora BRT 2005). Elkhorn coral is common in waters up to 50 feet (15 m) deep, but is most frequently found in waters less than 16 feet (5 m) deep. At these depths, colonies can be exposed at low tides and are particularly susceptible to increased energy during storm events (Acropora BRT, 2005). *Acropora* spp. are at risk for extinction due to susceptibility to shading and lowered water quality conditions, in addition to disease and the major population declines already suffered. A study done by Rogers (1983) showed that single applications of 0.1 ounces per cubic inch (200 milligrams per cubic centimeter) of sediment to colonies caused coral tissue death as the sediments accumulated on the branches of the species. This study suggests that shading from the Offshore GasPort may adversely affect any *Acropora* spp. in the shaded area, resulting in reduced colony viability, or mortality. LNG carriers are expected to be moored at the terminal for approximately 183 days each year (50 deliveries per year at 88 hours each). Therefore shading from the LNG carriers could also adversely affect *Acropora* spp.

Orbicella annularis (boulder star coral) is divided into three sibling species (i.e., boulder star coral, *O. faveolata* (mountainous star coral), and *O. franksi* (star coral) in the western Atlantic and Caribbean due to differences in morphology, depth range, ecology, and behavior; however, this is a recent species division with some caveats (Brainard et al., 2011). Mountainous star coral is the most genetically distinct out of the three species. It grows in heads or sheets that may be smooth or have keels or bumps. Boulder star coral grows in columns that exhibit rapid and regular upward growth; the live colonies usually lack ridges or bumps. Star coral is distinguished by large, unevenly arrayed polyps that give the colony its characteristic irregular surface (Brainard et al., 2011). Historically, these coral species were abundant in many reefs; however, the population dropped significantly in the 1990s and 2000s. The potential for recovery is low due to slow growth and low recruitment. These species are hermaphroditic broadcast spawners, and post-settlement growth rates are slow.

Dendrogyra cylindrus (pillar coral) is a columnar coral that is rare but easily identified during surveys (Brainard et al., 2011). Juveniles are infrequently identified during surveys, and asexual reproduction is thought to be the major mode of population growth. Pillar coral is at risk due to low population density (which may be part of the reason sexual reproduction is rare), low population size, and disease (Brainard et al., 2011).

Mycetophyllia ferox (rough cactus coral) is an encrusting coral and is rare in Puerto Rico. It is hermaphroditic and reproduces by brooding (Brainard et al., 2011). Rough cactus coral is at risk due to rarity and disease.

Agaricia lamarcki (Lamarck's sheet coral) is an encrusting coral common at greater depths and can also occasionally be found in areas with less light than other corals (Brainard et al., 2011). The species has a thick skeleton and can be susceptible to breakage. Little is known about the reproduction of this species, but recruitment has been found to be very low (Brainard et al., 2011). Lamarck's sheet coral is at risk for extinction due to general degradation of conditions in the Caribbean and the susceptibility of this species to disease. However, it is found at greater depths than other species, where disturbances are less frequent (Brainard et al., 2011).

Dichocoenia stokesii (elliptical star coral) is spherical in structure and more common in shallower reefs. Colonies are gonochoric (i.e., male or female, rather than hermaphroditic) and spawning occurs twice per year. Juveniles are commonly found in nutrient poor waters, and the species has been shown to do well in these conditions (Brainard et al., 2011). Elliptical star coral is at risk due to population-level impacts from disease. However, some tolerance may occur due to the variety of habitats this species can inhabit (Brainard et al., 2011).

Queen Conch

The queen conch (*Strombus gigas*) is a candidate species for listing under the ESA. This herbivorous benthic marine invertebrate is found throughout the Caribbean, Gulf of Mexico, and the southeastern coast of the U.S. mainland. Queen conch are long-lived individuals, estimated to reach up to 30 years of age. They lay benthic eggs that hatch into larvae that are planktonic for 2 to 5 weeks before settling to shallow waters where they remain for up to 4 years (Stoner, 2003).

Queen conch have been shown to have several movement patterns. The first is a shift to deeper water as individuals' age. The second is a seasonal migration between foraging grounds on hard substrate and seagrass or algae beds and reproductive sites that are usually on sandy substrate (Glazer and Kidney, 2004). In the Caribbean, where reproduction primarily occurs in the summer, conch are found on sandy substrates either dormant or in a reproductive state (Stoner and Sandt, 1992). The remainder of the year they are found foraging on algae and other plant matter.

The queen conch fishery is important in the Caribbean and fishing is allowed within Puerto Rican waters. Queen conch were observed in the seagrass habitats along the pipeline route and at the Offshore GasPort location during the benthic habitat surveys conducted by Aguirre LLC.

4.6.2 General Impact and Mitigation

Construction of the Project would result in short-term, minor to moderate adverse impacts on threatened and endangered species. Overall the Project would require about 12 months of construction, which would overlap the time when humpback whales are commonly observed off the coast of Puerto Rico (January through May). Aside from general avoidance or isolation from preferred habitat due to construction activities, the most notable effects would likely be to protected coral species as a result of the proposed direct impact of pipe lay covered with concrete mats within the Boca del Infierno pass and associated habitat alteration. Noise impacts on manatees, humpback whales, sea turtles, birds, seahorses, and sharks as a result of construction may also cause moderate adverse impacts. Construction and operation of the Project would result in permanent, minor adverse impacts on protected species from increased vessel traffic, shading, anti-fouling agents, thermal plume discharge, noise, and lighting; permanent, moderate adverse impacts from habitat alteration/loss associated with the pipeline; and short-term, moderate to minor adverse impacts from sedimentation and potential inadvertent spills of hydrocarbon materials.

The 12-month duration of the Project construction and the magnitude of Project impacts on seagrass beds are a major concern for the Antillean manatee and sea turtles. Construction activity and noise may displace manatees and sea turtles from important habitats such as foraging or resting areas within the Jobos Bay, altering normal manatee behavior within a high manatee use area. As a result, manatees and sea turtles may be forced to use other areas that may be less suitable or be exposed to greater threats such as areas with higher boat traffic. Activities which lead to incidental take of Antillean manatees are not authorized under the MMPA and, therefore, cannot be authorized under the ESA. Any activity that has the potential to result in incidental take should be modified to the extent that take is no longer reasonably certain to occur. Several recommendations, outlined below and in section 4.5.3.3 have been provided to further mitigate and reduce the potential of an incidental take of an Antillean manatee and to reduce impacts on sea turtles during Project construction activities.

Aguirre LLC is in the process of developing, in discussion with the NMFS, FWS, DNER, and other appropriate agencies, a pre-operations ichthyoplankton baseline survey and monitoring plan. The plan would help to further characterize the ichthyoplankton at the Offshore GasPort to understand potential impacts associated with operations of the proposed facility and water use required for construction activity.

Increased Vessel Traffic and Vessel Strikes

General impacts and mitigation measures regarding increased vessel traffic and vessel strikes are discussed in section 4.5.3.3. Manatees within Jobos Bay have the highest potential for impact as they are known to forage within the Project area, and vessel strikes in shallow water are a major source of mortality. Foraging may be disrupted by the physical presence of vessels and equipment. Manatees have been shown to respond to approaching vessels by changing fluke rate, heading, and dive depth (Southall, 2005). Although construction activities would temporarily increase vessel traffic in the Project area, operation of the Project would result in a 90 percent decrease in barge traffic within Jobos Bay, decreasing the current risk of vessel strikes on protected species within the bay.

The increased vessel traffic could disrupt vocalizations associated with breeding behavior of humpback whales; whales are known to change their behavior in response to anthropogenic noise, including ship traffic (Office of National Marine Sanctuaries, 2010; Reeves, 1992). Increased vessel traffic could potentially interrupt mother humpback whales with neonates traveling in the offshore area of the Project. The increase in vessel traffic could change their migration route or disrupt nursing events which could increase the risk of their mortality by placing them in areas where they are more vulnerable to predators or by reducing their conserved energy reserves (Office of National Marine Sanctuaries, 2010; Reeves, 1992.

Sea turtles can be injured or killed if struck by a vessel, particularly if struck by an engaged propeller. Increased vessel traffic could result in a higher number of collisions between ships and sea turtles, thereby increasing the occurrence of sea turtle injuries or fatalities. Although adult sea turtles can be visible at the surface during the day and in clear weather, they are difficult to spot from a moving vessel when resting below the water surface or during nighttime or periods of inclement weather. Sea turtles spend most of their lives submerged and thus are difficult to see by vessel operators. Green sea turtles in Tampa Bay spent an average of 91 percent of their time submerged (Meylan et al., 2003). The risk of a vessel striking a sea turtle cannot be easily quantified; however, turtle stranding networks have compiled useful data. A total of 122 records (from 1982 through 1997) of dead or injured turtles exist for the U.S. Virgin Islands for 1982 through 1997 (Abreu-Grobois et al., 2000). During this period, annual reported strandings have ranged from 1 to 25 with a trend showing a gradual increase in reported strandings (Abreu-Grobois et al., 2000). Strandings have included 79 green, 38 hawksbill, and 5 leatherback turtles (Abreu-Grobois et al., 2000). Boat-related injuries account for the greatest number of strandings (34.4 percent) followed by undetermined causes (29.5 percent), poaching (13.1 percent), other (12.3 percent), and fishing gear entanglement (10.7 percent; Abreu-Grobois et al., 2000). Most green turtle strandings are due to boat strikes, likely due to their selection of shallow bay habitats where boats are more commonly operated, while most hawksbill strandings are from poaching (Abreu-Grobois et al., 2000).

Any vessel strike of a threatened or endangered marine mammal would be considered a 'take' under both the MMPA and ESA. Any vessel strike of a threatened or endangered sea turtle would be considered a 'take' under ESA. While it is known that an increase in vessel traffic increases the risk of collision, the probability of that risk cannot be easily quantified. Based on the mitigation measures proposed by Aguirre LLC (e.g., certified MMOs and reduced vessel speeds) and based on our additional recommendations in section 4.5.3.3 that would further protect wildlife from vessel strikes and traffic during construction, the impact of vessel traffic and vessel strikes during construction is anticipated to be short-term and negligible for whales and sea turtles, and short-term and minor for manatees. The impact of vessel traffic and vessel strikes during operation is anticipated to be permanent but minor for whales, manatees, and sea turtles.

Hydrostatic Testing

Hydrostatic testing procedures, general impacts, and mitigation measures are described in section 4.5.2.4. The intake of water is anticipated to have negligible impact on juvenile and adult protected species in the Project area, as they are all large enough to avoid entrainment and mobile enough to avoid the intake area. The impact of entrainment and impingement of larvae is addressed in section 4.5.4.3. The discharge would be directed through a pipe secured about 6 feet (2 m) below the bay's water surface to minimize surface disturbance. To reduce discharge velocity and minimize sediment resuspension at the point of discharge, a diffuser head would be attached to the discharge pipe during dewatering operations. Disturbance of the benthic cover and sediment resuspension proximate to the discharge location are expected to have short-term and minor impacts on protected species.

Sediment Resuspension

General impact and mitigation information regarding sediment resuspension is discussed in section 4.5.2.4. An increase in turbidity due to sediment resuspension from installation of the proposed moorings and lowering the pipeline using hand-jetting techniques has the potential to adversely affect protected species. In particular, coral species could be smothered as resuspended sediments settle back to the bottom. Additionally, increased sedimentation could impact seagrasses which serve as foraging habitat for protected sea turtles, mammals (including the Antillean manatee), fish, and invertebrate species. Turbidity-related impacts can include reduced light availability, reductions in growth and feeding rates, the clogging of respiratory structures, and/or death. While all species of coral may be impacted from sedimentation, the two ESA-listed coral species, elkhorn and staghorn coral, are particularly susceptible to smothering which could result in localized impacts at moderate levels. Other species, including reef fish, are mobile and therefore able to avoid areas of temporarily high-suspended sediments. Overall, turbidity increases would be temporary in duration and localized in scope, so the impact on protected species is expected to be short-term and minor, except for coral species where the impact could be moderate. However, the pilings, potentially areas where concrete mats would be placed above grade with the natural seafloor, and the portion of direct-lay pipeline proposed to be covered with concrete mats in the Boca del Infierno pass could also result in persistent siltation and turbidity from scour and sediment deposition, reducing light penetration and lowering photosynthesis rates and primary productivity in the area. Water discharges from the LNG carriers could also cause sediment resuspension at the Offshore GasPort during operation. Turbidity increases associated with scour and the LNG carrier discharges would be localized in scope, so the impact on protected species is expected to be permanent but minor.

Noise

General impacts and mitigation information, as well as current noise levels and modeling results in the Project area are discussed in section 4.5.3.3. Additional species-specific impacts are described below. With the proposed and our recommended mitigation measures in place, impacts on whales and sea turtles in the offshore environment are expected to be minor. These animals are highly mobile and would be able to avoid areas of noise that would cause them discomfort or harm. Humpback whales have been documented to change their migration routes to avoid anthropogenic noise sources potentially resulting in whales expending more energy or moving to a location where they are more vulnerable to predators. The songs of humpback whales could be potentially masked leading to the disruption of breeding activity and behavior. Sea turtles may be deterred from entering Jobos Bay due to construction activities; however, this is expected to be a short-term minor impact. Manatees within Jobos Bay may experience short-term moderate impacts because they may not be able to escape the elevated noise levels within the bay. Sirenians (manatees and dugongs) appear to have a relatively narrow range of hearing sensitivity (approximately 5 kilohertz to 30 kilohertz) based on the limited available data (Southall, 2005). Most of the acoustic energy radiated from large commercial vessels is below 1 kilohertz; therefore, the greatest potential for masking exists for groups of marine animals that produce and receive sound in this band for biological functions which primarily includes mysticetes, pinnipeds, and fish (Southall, 2005).

The biological significance of hearing in sea turtles remains largely unstudied, but it is likely that they use sound for navigation, to locate prey, to avoid predators, and for general environmental awareness (Piniak, 2012). Sea turtles do not appear to use sounds for communication (Piniak, 2012). Sea turtles are able to detect much of the intense and prevalent low-frequency sound (50 to 2,000 hertz) in the ocean such as those produced by oil and gas exploration and extraction, low frequency naval sonar, pile driving, and shipping (Piniak, 2012). Little data exist on the behavioral responses of sea turtles to anthropogenic sound; however, several studies have examined the behavioral response of sea turtles to seismic airguns (McCauley et al., 2000; Piniak, 2012). Studied responses include erratic and increased swimming behavior to move away from airguns and increased diving behavior described as a 'startle response' (McCauely et al., 2000; Piniak, 2012). Studies have demonstrated that sea turtles exposed to underwater explosions associated with the removal of oil and gas structures resulted in death or injury (Keevin and Hempen, 1997). A study by McCauley et al. (2000) determined that a reference behavioral disturbance threshold for sea turtles is 166 dB.

Pile driving occurs over small spatial and relatively short temporal scales (depending on the construction activity) and produces high-intensity low-frequency sounds that can be detected by sea turtles. The main noise sources during construction activities are pile driving using vibratory and impact hammering, and vessel engines. Pile driving activities for the Project may overlap when sea turtles are primarily found off the coast of Puerto Rico (August and February). Pile driving conducted in the offshore waters would not likely impact sea turtles foraging or potentially breeding in the nearshore waters of Jobos Bay. Sea turtles within Jobos Bay during the temporary pile driving activity may be adversely impacted by the short-term activity. Avoidance behavior could be expected to occur at distances ranging from a few meters to a few hundred meters from a pile driver. Exposure to pile-driving noise could interrupt feeding, resting, or other behaviors or could cause a turtle to change its course of travel. The interruptions might continue for as long as the pile driving continues, or until the sea turtle could swim outside of the zone of influence. Short-term changes in activity that reduce the amount of time feeding could represent long-term challenges by reducing energy acquisition. Because of the limited areal extent of impacts, the short duration of the pile-driving activity, and proposed mitigation to reduce noise associated with construction (i.e. ramp-up piling driving and potentially installing bubble curtain technology during pile driving activity), minor, short-term impacts on sea turtles are expected.

All species of sea turtles could be exposed to construction vessel noise. Although sounds created by construction equipment and vessels would be continuous during pipeline installation, activities would progress slowly along the route as the pipeline and offshore platform is under construction. Thus, any one area would be subject to the maximum sound levels for only a day or two each time as the construction activities pass that area. It is likely that sea turtles would be able to hear low-frequency underwater noise from construction vessels and possibly experience some disturbance. The most likely impacts would be short-term behavioral changes such as diving and evasive swimming, disruption activities, or departure from the area.

Several mitigation measures have been proposed to address these short-term impacts on sea turtles if they occur in or near the Project area during construction activities. Mitigation measures are described in section 4.5.3.3 and include the use of a MMO on each vessel during project construction and the establishment of an exclusion and monitoring zone, detailed MMO response plans, the creation of a detailed noise mitigation plan, the use of the ramp-up procedure during pile driving activities to provide a warning mechanism to marine life, as well as the potential use of bubble curtains to reduce noises associated with pile driving activities.

Protected bird species in or adjacent to the Project area may experience short-term moderate impacts as they may be temporarily displaced from areas with elevated noise levels. Snowy plover and/or yellow-shouldered blackbird nesting seasons may be impacted during the months of March to August if construction activities take place then. Brown pelicans nest irregularly in the area, usually beginning in late fall and extending through June during which noise may cause them to abandon their nests. We are recommending in section 4.5.3.3 that Aguirre LLC provide additional information related to noise impacts on birds and associated mitigation measures that it would implement.

Impacts on protected marine mammals, sea turtles, and fish in the offshore environment resulting from operation of the Project are expected to be permanent but minor. These animals are highly mobile and would be able to avoid areas of noise that would cause them discomfort or harm.

Inadvertent Hydrocarbon Spills

General impact and mitigation information regarding inadvertent hydrocarbon spills are described in section 4.5.2.4. Minor releases of hydrocarbons during construction could result in short-term, minor to moderate adverse impacts on protected species. Accidental releases of hydrocarbons resulting from operation of the Project area expected to have short-term and minor to moderate impacts on protected species. As described in section 4.3.3.3, construction contractors and port operations personnel would be required to comply with all laws and regulations related to handling of fuels and lubricants, and Aguirre LLC would prepare a site-specific Spill Prevention and Control Plan for construction and operation to minimize the potential for inadvertent release. We are recommending in section 4.3.3.3 that Aguirre LLC provide this plan for review and approval prior to construction. In addition, we are recommending in section 4.5.3.3 that Aguirre LLC provide a response plan that identifies measures that would implemented if wildlife, including federally listed species or migratory birds, are impacted by an inadvertent hydrocarbon spill. With these measures, we conclude that impacts on ESA proposed and listed species would be minimized to the extent practicable.

Habitat Alteration/Loss

Overall habitat modification impact information and acreages for benthic resources used by protected species (seagrasses, corals, and macroalgae) are discussed in section 4.5.2.4. The impact of temporary habitat modification/loss on protected species varies. Birds in the onshore portion of the Project area as well as marine mammals, sea turtles, birds, and fish in the offshore portion of the Project area would likely move away from areas of disturbance to other similar, adjacent habitats. Temporary destruction of approximately 22.6 acres (23.3 cuerdas) of seagrasses and 80.8 acres (83.1 cuerdas) of macroalgae during construction would be a loss of foraging habitat for manatees, sea turtles, seahorses, queen conch, and fish. Aguirre LLC has developed a draft Benthic Resources Mitigation Plan to compensate for impacts on these habitat types. We are recommending in section 4.4.3 that Aguirre LLC submit a final plan prior to construction. Given the limited scope of the Project area and Aguirre LLC's mitigation measures, we conclude habitat impacts during construction would be short-term and minor for most protected fish, bird, marine mammal, and sea turtle species.

Construction could result in short-term moderate impacts for the dwarf seahorse and other seahorse species, and permanent, moderate impacts for protected corals. Seahorses have the potential to occur in seagrass habitats in Jobos Bay; destruction of seagrass could result in direct mortality to seahorses, as it is unlikely that they would be able to escape. Impacts on protected coral species could occur from disturbance to the water column and seafloor resulting in increased sedimentation that could impact colonies near construction activities. Additionally, coral species within the pipeline alignment could be impacted during pipeline placement which would result in physical damage to or destruction of the colony. Coral growth rates have been observed to range from 2 to 5 percent per year (Osborne et al., 2011), thus, recovery may be on the order of years to decades. Seagrass and coral reef mitigation is discussed in sections 4.4.3 and 4.5.2.4, respectively.

The loss of seagrass and coral reef habitat could result in a permanent impact on protected manatees, sea turtles, seahorses, queen conch, and fish. NMFS has expressed its grave concern regarding the pipeline's potential impacts on coral reef habitat. The direct lay of the pipeline segment within Boca del Infierno pass with the use of concrete mats, as proposed, could lead to a lengthy and complex consultation process. We are recommending in section 4.5.2.4 that Aguirre LLC conduct a feasibility analysis of constructing using the HDD construction method under Boca del Infierno pass with the intent to alleviate the NMFS' concerns and substantially reduce impacts on coral reef habitat. If Aguirre LLC finds that the HDD construction method is feasible, implementation of this construction technique as a method of avoidance or minimization of impacts would likely expedite formal consultation with NMFS. However, if the HDD is determined to be infeasible, we are recommending that Aguirre LLC construct Alternative Route 6, as an alternate measure to greatly reduce impacts on coral reef habitat and federally listed species.

We are also recommending in section 4.4.3 that Aguirre LLC include mitigation for 2.9 acres (3.0 cuerdas) of seagrass impacts associated with the location of the Offshore GasPort and submit a final Benthic Resources Mitigation Plan. With these mitigation measures in place, we conclude the loss of coral and seagrass habitat as a result of the Offshore GasPort and pipeline operation would be minimized to the extent practicable. The presence of the permanent structure in the offshore could be a beneficial effect for brown pelicans, as it may provide roosting habitat as they travel and feed over the coastal waters.

The inshore habitat of Jobos Bay would be altered by the presence of the pipeline which could act as a physical deterrent that bisects the bay. Laboratory experiments indicate that queen conch are capable of gliding vertically and therefore may be able to climb over a structure like the pipeline (Hesse, 1980). However, DNER staff noted that an existing water pipeline between Isla Culebra and Isla Vieques has proven to be a serious barrier to queen conch movements (Lilyestrom, 2014). Therefore, the pipeline would likely present a barrier to migration for queen conch, representing a permanent, moderate impact for the species. We are recommending in section 4.5.2.4 that Aguirre LLC assess the potential for the use of a HDD to avoid impacts on coral reef habitat; if such an HDD is feasible, this would also reduce the length of exposed pipe and potential impacts on queen conch.

Shading

General impacts from shading on benthic resources (e.g., corals and SAV) utilized by protected species are discussed in section 4.5.2.4. A federally protected coral species (pillar coral) was identified in the Offshore Gasport area during the benthic survey. Impacts on this species and other coral species in the patch reef, all of which are protected under Puerto Rico law, are expected. In addition, a temporary reduction in seagrass productivity due to shading could result in loss of habitat for manatees, sea turtles, dwarf seahorse, fish, and queen conch. We are recommending in section 4.4.3 that Aguirre LLC finalize the Benthic Resources Mitigation Plan in consultation with the appropriate agencies. We are also recommending that Aguirre LLC account for the impacts on 2.9 acres (3.0 cuerdas) of seagrass due to shading from the Offshore GasPort, and file a final Benthic Resources Mitigation Plan.

Thermal Plume Discharge – Offshore Gasport

General impacts and mitigation information regarding thermal plume discharge from the Offshore GasPort are discussed in section 4.5.2.4. The thermal plumes from operation discharges may have a minor impact on protected coral species within the Offshore Gasport area. A comment was received in response to the draft EIS stating that manatees are known to move to offshore structures where warm water is a by-product, and if Antillean manatees are attracted to the thermal plume they may become dependent on the source and may be susceptible to vessel strikes. However, the FWS provided comments on the draft EIS and stated that maximum temperature thermal tolerance of manatees has not been studied and may deter them from using areas if temperatures are too high for them. An additional thermal plume discharge may result in cumulative thermal effects on possible feeding resources for the manatee in the area. Since thermal plume from the Project would occur at the Offshore GasPort where manatees are less common, the FWS concurs that thermal discharge effects on the manatee would be low. Impacts on other protected species are expected to be minor, as mobile organisms would be able to move out of the zone of heated water.

Seawater Intake

Construction and operational uses of seawater have the potential to adversely affect populations of queen conch, Nassau grouper, goliath grouper, and protected corals via entrainment of larval stages. Entrainment impacts are discussed in section 4.5.4.3. Aguirre LLC is currently developing a pre-operations coral larvae baseline survey and monitoring plan. The plan would help to further characterize the coral larvae at the proposed Offshore GasPort location and understand the potential impacts associated with proposed water use for construction and operations of the Project. We are recommending in section 4.5.4.3 that, once this additional baseline study is complete, Aguirre LLC develop mitigation measures for entrainment impacts on coral larvae associated with Project operations and water use required for construction activities.

Sea turtles are not anticipated to be impacted by seawater intake. The water intake velocity (through-screen) would be maintained below 0.5 feet/s (0.2 m/s) independent of vessel size. The speeds of several measured sea turtle hatchling species are faster than both the average and maximum intake velocities, so hatchlings would be able to outswim the seawater intake. Average swimming speeds for sea turtle hatchlings are 1.43 ft/s (0.44 m/s) for green turtles, 1.17 ft/s (0.36 m/s) for loggerhead turtles, and 0.83 ft/s (0.25 m/s) for leatherback turtles (Wyneken, 2001). In addition, hatchlings are not anticipated to occur within the Project area because there are no recent records of sea turtles nesting in the area. The closest known nesting beach is 20 miles (32 km) from the Project area. Only juvenile and adult sea turtles are likely in the area and they would be capable of outswimming the seawater intake associated with the Project.

Indirect, adverse impacts on sea turtles related to seawater intake would primarily be associated with the impingement or entrainment of marine organisms. Impingement would occur if organisms became trapped against the seawater intake screens; entrainment would occur if small marine organisms were drawn into the seawater intake system. The mortality rate of all entrained organisms is assumed to be 100 percent. The entrainment and subsequent mortality of these small organisms (i.e. ichthyoplankton) would potentially impact the juvenile and hatchling sea turtles that feed on them. However, as noted above, hatchling sea turtles are not anticipated because there are no known nesting beaches within the Project area. Considering the overall availability of food in the area, these impacts would likely be immeasurable, if they occurred.

Anti-fouling Agents

General impact and mitigation information regarding anti-fouling agents are described in section 4.5.2.4. To prevent macrofouling of the FSRU's raw water intake systems, the FSRU would utilize its on-board copper-aluminum anode MGPS. The MGPS would release, on average, 2 ppb of copper ions at the beginning of the system, which is below the EQB Class SB/SC water quality standard of 3.73 ppb for copper discharge. Copper levels are expected to be lower than 2 ppb at the discharge location due to the copper ions coating the linings of the FSRU piping. The residual discharge of copper would meets the EQB Class SB/SC water quality standard and is not expected to significantly affect water quality, due to the low concentrations of copper discharge. Impacts of copper discharge associated with the MGPS on rare and endangered marine wildlife species are expected to be minor to insignificant since marine mammals and sea turtles may pass through the outfall area and/or the unlikely chance that they could consume organisms that bioaccumulated cupric ions associated with the outfall area.

Scour

General impacts and mitigation regarding scour are discussed in section 4.5.2.4. Scouring along the pipeline within the Boca del Infierno pass, at pilings, or potentially where concrete mats are placed, could contribute to a loss of habitat for protected corals, fish, queen conch, seahorses, sea turtles, and manatee utilizing Jobos Bay. Overall, the impact of scour on the protected species is anticipated to be permanent but minor.

Lighting

Lighting procedures, general impacts, and mitigation information are described in section 4.5.3.3. Generally, impacts on protected species would be minor as these species may change their feeding habits based on artificially induced biological aggregations. However, for species that use moonlight to time spawning events the impact could be more noticeable. There is evidence of queen conch, Nassau grouper, and many coral species using the full moon to time spawning events. If species are not successful in synchronizing spawning events, there is the possibility for reduced fecundity and genetic recombination, and the ultimate degradation of genetic diversity.

The additional artificial light could also cause disorientation for sea turtles in the area which use cues from the moon to direct movements. However, sea turtles are the most vulnerable to the effect as hatchlings. Because there are no known nesting beaches in the vicinity of the Project area, this effect is unlikely to cause appreciable impact.

Overall, with mitigation measures in place, the effect of operational lighting on protected species is expected to be permanent but minor due to the highly localized nature of the impact. We are recommending in section 4.5.3.3 that Aguirre LLC develop a lighting plan that identifies specific measures that it would implement to minimize impacts associated with nighttime lighting.

4.6.3 Determination of Effects under the Endangered Species Act

Table 4.6.3-1 summarizes our effects determinations for the Project under Section 7 of the ESA. These determinations were based on the species' characteristics, habitat requirements, proposed construction and operation procedures, Aguirre LLC's proposed mitigation methods, and our recommendations. Once the final pipeline route is determined (either an HDD under the Boca del Infierno pass or Alternative Route 6), the BA will be prepared and submitted to the FWS and NMFS. At that time, we will submit a request for informal and formal consultation to comply with Section 7 of the

ESA. This consultation will address species-specific details, which should not change for most species regardless of the final pipeline design or route. Thus, we have enough information to make final effects determinations in this EIS for most species. The exception is for the federally listed corals. Based on the pipeline route as proposed, we conclude that the Project is likely to adversely affect federally listed corals. However, this conclusion is conservative; that is, there is a potential that the effects would be much less based on our recommendations regarding the pipeline in the Boca del Infierno pass.

TABLE 4.6.3-1

Determination of Effects for Federally Listed, Proposed, and Candidate Species

Common Name	Scientific Name	Federal Status [a]	Determination [b]
Marine Mammals			
Antillean Manatee	*Trichechus manatus manatus*	E	LAA
Blue whale	*Balaenoptera musculus*	E	NLAA
Fin whale	*Balaenoptera physalus*	E	NLAA
Humpback whale	*Megaptera novaeangliae*	E	NLAA
Sei whale	*Balaenoptera borealis*	E	NLAA
Sperm whale	*Physeter macrocephalus*	E	NLAA
Reptiles			
Green sea turtle	*Chelonia mydas*	T, CH	NLAA, NLAM
Hawksbill sea turtle	*Eretmochelys imbricata*	E, CH	NLAA, NLAM
Leatherback sea turtle	*Dermochelys coriacea*	E, CH	NLAA, NLAM
Loggerhead sea turtle	*Caretta caretta*	T	NLAA
Birds			
Yellow-shouldered blackbird	*Agelaius xanthomus*	E	NLAA
Fishes			
Dwarf seahorse	*Hippocampus zosterae*	C	NCTFL
Great hammerhead shark	*Sphyrna mokarran*	C	NCTFL
Nassau grouper	*Epinephelus striatus*	PT	NLAA
Scalloped hammerhead shark	*Sphyrna lewini*	T	NLAA
Invertebrates			
Queen conch	*Strombus gigas*	C	NCTFL
Boulder star coral	*Orbicella annularis*	T	LAA
Elkhorn coral	*Acropora palmata*	T, CH	LAA, LAM
Mountainous star coral	*Orbicella faveolata*	T	LAA
Pillar coral	*Dendrogyra cylindrus*	T	LAA
Rough cactus coral	*Mycetophyllia ferox*	T	LAA
Staghorn coral	*Acropora cervicornis*	T, CH	LAA, LAM
Star coral	*Orbicella franksi*	T	LAA

[a] E = Endangered, T = Threatened, PT = Proposed for Threatened Status, CH = Critical Habitat, C = Candidate

[b] LAA = Likely to Adversely Affect, NLAA = Not Likely to Adversely Affect, NLAM= Not Likely to Adversely Modify, NCTFL= Would Not Cause a Trend toward Federal Listing, LAM= Likely to Adversely Modify

4.7 LAND USE, RECREATION, AND VISUAL RESOURCES

This section discusses the current uses of the areas proximate to the Project and describes the potential impacts of the Project on land use, recreation, commercial fishing, visual resources, and associated issues. Impacts on commercial fishing are also evaluated in our socioeconomics discussion (see section 4.8.3). For the purposes of this draft EIS, land use is defined by the way in which humans use the air, land, or water.

4.7.1 Land Use

The Offshore GasPort would be located approximately 1 mile (1.6 km) south of Jobos Bay in waters of the Municipality of Salinas. The subsea pipeline would pass between Cayos de Barca and Cayos de Caribes and in waters of the Municipality of Salinas and the Municipality of Guayama. The pipeline would connect onshore directly within PREPA's existing Aguirre Plant located in the community of Central Aguirre, Municipality of Salinas. Onshore facilities would include a meter station, pressure reducing equipment, a pig launcher/receiver, a construction office, and an onshore construction staging area. The onshore facilities would be entirely within the property of the Aguirre Plant. Table 4.7.1-1 summarizes the anticipated impacts associated with construction and operation (temporary and permanent) of the Project. The USCG is proposing to establish a radius of 500 yards (457 m) centered on the Offshore GasPort site.

TABLE 4.7.1-1

Summary of Proposed Construction and Operation Impacts Associated With the Aguirre Offshore GasPort Project

Project Component	Temporary Impacts During Construction: Water Surface (acres [cuerdas])	Temporary Impacts During Construction: Seafloor [a]/Upland (acres [cuerdas])	Permanent Impacts During Operation (acres [cuerdas])
Offshore Gasport	75.5 (77.7)	75.5 (77.7)	22.3 (22.9)
Subsea Interconnecting Pipeline	48.9 (50.3)	17.8 (18.3)	0.6 (0.6) [b]
Offshore Lay Barge Construction Areas	36.6 (37.7)	36.6 (37.7)	0.0
Onshore Temporary Staging and Support Area [c]	0.0	1.5 (1.5)	0.0
USCG Safety Zone	0.0	0.0	303.3 (312.3)
TOTAL	**161.0 (165.7)**	**131.4 (135.2)**	**326.2 (335.8)**

a Includes direct impacts on the seafloor from mechanical activities (e.g., pile and pipeline installation) and associated sedimentation. The proposed construction methods for the subsea interconnecting pipeline do not include use of mooring anchors or cables; therefore no temporary workspace would be required for the sweep of mooring anchor chains or cables. Estimates of the Offshore GasPort construction includes mooring and anchor chain acreages.

b Permanent impacts include areas where the pipeline would be above grade and/or covered in concrete mats.

c Located within the existing Aguirre Plant property.

Jobos Bay and the surrounding areas are used for a variety of marine activities, including recreational boating, recreational and commercial fishing, scientific research, and other recreational activities such as snorkeling and wildlife viewing. Jobos Bay and the open sea south of the bay are also used by various shipping vessels, including the barges that currently deliver fuel oil to the Aguirre Plant. Other shipping activity in the region includes:

- The AES Corporation Total Energy coal fired power plant, located approximately 4 miles (6.4 km) east of the Project area. Receives coal and limestone deliveries approximately once each week. Exports manufactured aggregate (e.g., fly ash) from the facility approximately five times a week.

- The Port of Ponce, located approximately 26 miles (42 km) west of the Project area. Large industrial port with a variety of vessel traffic.
- EcoEléctrica, located approximately 35 miles (56 km) west of the Project area. The only existing LNG import facility in Puerto Rico; receives an average of two LNG carriers per month.

As shown in table 4.7.1-2, the majority of the vessel traffic within and around the bay is associated with commercial and recreational fishing. The numbers of weekly vessels shown in table 4.7.1-2 are estimates and may vary due to weather or other non-marine events.

TABLE 4.7.1-2

Estimated Weekly Vessel Traffic Within and Near Jobos Bay for the Aguirre Offshore GasPort Project

Vessel Type	Interior to Jobos Bay	South of Jobos Bay
Recreational Fishing Vessels	50 to 75	75 to100
Commercial Fishing Vessels	35 to 45	40 to 50
Diving Vessels	1 to 5	Not Available
Fuel Oil Barges or Ocean-going Vessels	3 to 4	8 to 10
Vessels to AES Coal	0	1
LNG Vessels to the EcoEléctrica LNG Facility	0	1 to 2

Source: Tetra Tech, 2013f

4.7.2 Jobos Bay National Estuarine Research Reserve

The JBNERR was designated in 1981 and includes parts of Jobos Bay and the surrounding barrier islands (cays). The National Estuarine Reserve System was created by the CZMA to provide a network of protected areas established to promote informed management of the Nation's estuaries and coastal habitats. The JBNERR is the only estuarine reserve in Puerto Rico and the greater Caribbean, and is one of two reserves representing the West Indian Biogeographic Region. Located on the southern coast of Puerto Rico, the JBNERR encompasses approximately 3,300 acres (3,398 cuerdas) of coastal ecosystems. The habitats within the reserve boundaries include mangrove forests, salt flats, coastal strand, beach dunes, seagrass beds, algae beds, and coral reefs. These coastal resources are surrounded by the local communities of Las Mareas, Coqui, and Aguirre in the Municipality of Salinas and the communities of Puerto de Jobos, Punta Pozuelo, and Puente de Jobos in the Municipality of Guayama (DNER, 2010).

The JBNERR is managed by the DNER and is partially funded by NMFS. The DNER maintains a management plan for the JBNERR, which is updated every 5 years. The current management plan is valid until 2015, and identifies the management plan goals as: ensure a stable environment for research; address coastal management issues; enhance public awareness and understanding of estuarine areas; promote federal, state, public, and private research use; and gather and make available information necessary for improved understanding and management of estuarine areas (DNER, 2010).

To promote multiple uses within the JBNERR, the JBNERR is divided into three separate management sector classifications: preservation, conservation, and limited use (see figure 4.7.2-1). The preservation sector is the core area of the JBNERR, and activities within this sector are limited to research and monitoring activities. The conservation sector covers areas that require protection against inappropriate or excessive use; the types of activities within this sector are limited to low impact activities such as hook and line fishing, anchoring on mooring buoys, and permitted collection of dead coral. Activities not permitted in the conservation sector include net fishing, extraction of corals or related fish species, and anchoring without mooring buoys. The limited use sector is a buffer area around the conservation and preservation sectors, and is primarily designated for public access. Activities within the limited use sector are those that will not threaten or significantly disturb the natural ecosystem. As shown on figure 4.7.2-1, the subsea pipeline would cross portions of the conservation sector. An HDD under Boca del Infierno pass would result in a smaller portion of the conservation sector affected by the pipeline. The preservation and limited use sectors would not be crossed by any part of the Project.

Scientific Research

According to the DNER Research Coordinator at the JBNERR, there are eight ongoing research projects, three monitoring programs, and one proposed research and monitoring project within the JBNERR (Dieppa, 2013). The ongoing and proposed research and monitoring projects are listed below.

The ongoing research includes:

- Effects of Nutrient Pollution on Mangrove Functioning (Odum School of Ecology, University of Georgia);
- Ecological and Biogeochemical Responses to Experimental Nutrient Enrichment in Coastal Fringe and Basin Mangrove Systems (University of Rhode Island);
- Passive Harbor Acoustic Monitoring in Puerto Rico (University of Puerto Rico, Mayaguez);
- A Comparison of the Arthropod Fauna among Mangrove and Dry Forests, and Agricultural Fields in the Jobos Bay Area, Puerto Rico (University of Turabo);
- Short-term Impact of Black Mangrove Restoration on Avian Biodiversity and Breeding Ecology Along the Northern Boundary of JBNERR (Michigan State University);
- Interhabitat Connectivity of Wintering New England Songbirds on the South Coast of Puerto Rico: Development of an Emerging Paradigm in the Face of Global Warming (University of Turabo);
- Habitat Use by Yellow Warblers and Interactions Between Migratory and Residential Individuals (University of Turabo); and
- The Influence of Habitat Composition and Food Availability on Migratory and Resident Bird Abundance and Diversity in a Subtropical Dry Forest in Southeastern Puerto Rico (University of Turabo).

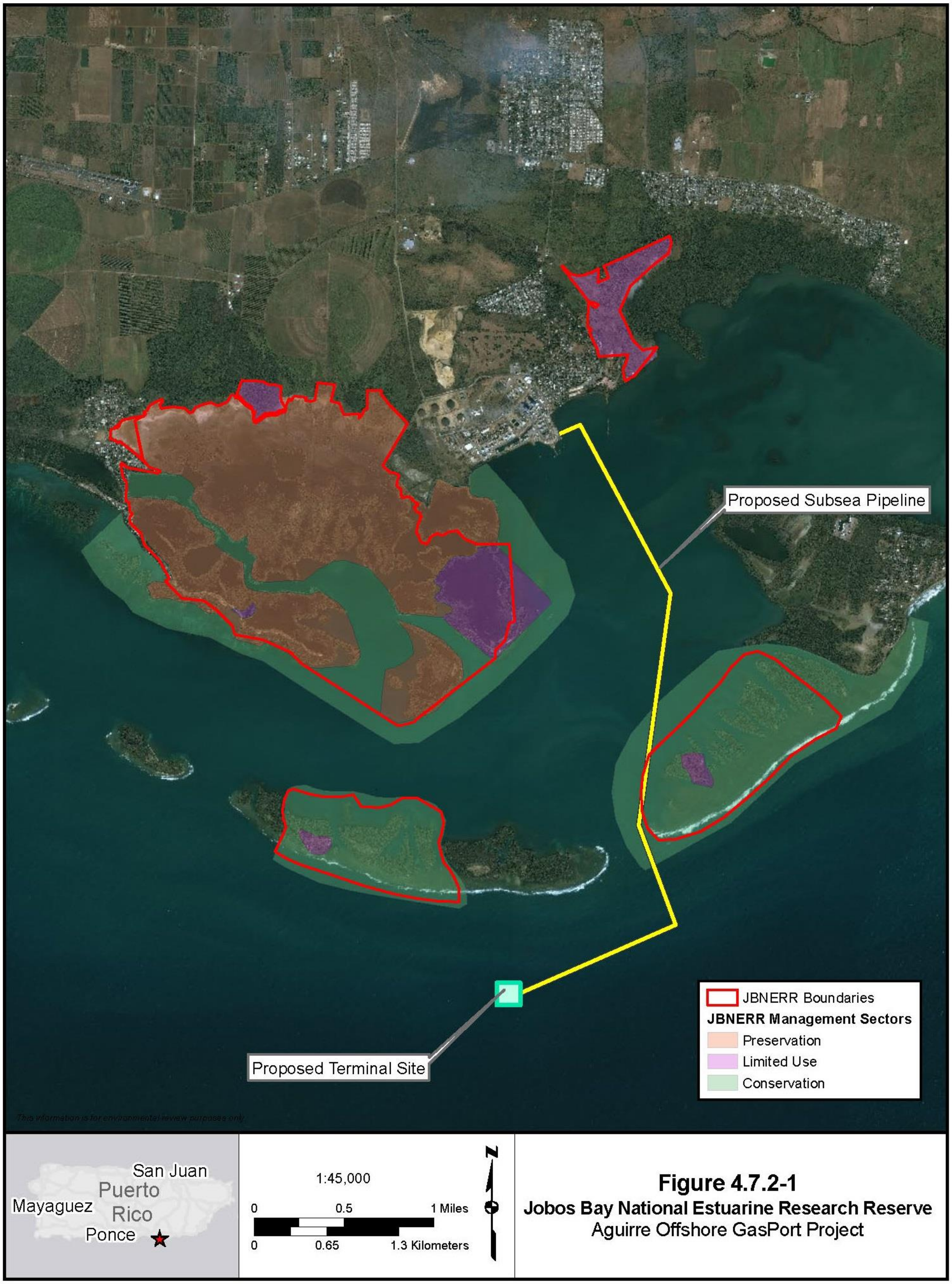


Figure 4.7.2-1
Jobos Bay National Estuarine Research Reserve
Aguirre Offshore GasPort Project

The monitoring programs include:

- System-wide Monitoring Program for Water Quality in Four Stations Within Jobos Bay and Meteorological Monitoring, conducted by the JBNERR;
- Aquifer Water Level Monitoring in Several Wells, conducted by the JBNERR, Agricultural Research Service; and
- Accounting for Agricultural Best Management Practices by Monitoring Agricultural Runoff in the Estuary During Heavy Rain Events, conducted by the JBNERR in collaboration with the USDA, Agricultural Research Service.

The proposed research and monitoring includes:

- JBNERR Sentinel Site Program, to establish a series of monitoring stations and transects to study the effects of climate change/sea level changes on SAV and mangrove communities.

4.7.3 Coastal Zone Management Program

Puerto Rico's CZMP is authorized by the CZMA and is administered at the federal level by the Coastal Programs Division of NOAA's Office of Ocean and Coastal Resource Management. The consistency provisions of the CZMA require federal agency actions to be consistent with each state's federally approved CZMP. Puerto Rico approved its CZMP in 1978 as a part of its Land Use Plan. The CZMP is administered by the DNER, and developments within the coastal zone require a review by the PRPB in order to ensure consistency under the federal CZMA. The goals of the CZMP are to develop guidance for public and private development on the coastal zone; conduct active management of coastal resources; and foster scientific research, education, and public participation as a means of promoting sustainable develop of Puerto Rico's coastal zone and coastal resources. States (including the Commonwealth of Puerto Rico) with federally approved CZMPs have the responsibility of reviewing federal agency actions and activities to ensure that they are consistent with the goals and policies of the state's program. Applicants for federal permits in coastal areas must provide the federal agency with a consistency certification from the state, showing that a proposed project is consistent with the state's CZMP.

The coastal zone in Puerto Rico generally extends 0.6 mile (1.0 km) inland but extends further inland in some areas to include key ecosystems along the coast (DNER, 2008). The coastal zone is divided into eight Coastal Sectors based on socioeconomic, ecological, geological, and topographic characteristics. The Project is within the South Coastal Management Sector, which extends from the Rio Grande in Patillas to the Rio Tallaboa in Peñuelas (DNER, 2008). Within this coastal zone sector, the JBNERR is designated as a Special Planning Area (SPA).

SPAs are defined as "important coastal resource areas subject to serious present or potential use conflicts, and, therefore, require detailed planning" (DNER, 2010). SPAs emphasize a consensus-based approach among all federal, commonwealth, and local entities on future development policy. The Project, including the Offshore GasPort and subsea pipeline, would be located within the designated Jobos Bay SPA. Since the Jobos Bay SPA extends from Guamani River in Guayama to Playa de Salinas and inland to Highway PR-53, which is all part of Puerto Rico's Coastal Zone, a considerable number of governmental agencies are participants in the SPA task force, including the COE, EPA, FWS, EQB, PRPB, Puerto Rico Land Authority, and DNER, among others. The participants in the SPA process create consensus derived planning agreements that are legitimized through a legally binding Memorandum of Understanding (DNER, 2010).

Aguirre LLC stated that it plans to complete a coastal zone consistency evaluation with the PRPB to determine the Project's consistency with the CZMP policies. The COE requires a concurrence certification with CZMP from the PRPB prior to issuing a permit. To ensure that Aguirre LLC receives its determination of consistency with the CZMP, **we recommend that:**

- **<u>Prior to construction</u>, Aguirre LLC should file with the Secretary a copy of the determination of consistency with the CZMP issued by the PRPB.**

4.7.4 Recreational Activities

Puerto Rico offers many types of coastal recreational opportunities for the public. Marine and onshore recreation activities are available year-round in and around Jobos Bay. Coastal recreation activities include recreational boating, recreational fishing, wildlife viewing, kayaking, diving, golf, and swimming/sunbathing at beaches. A sample of the recreational facilities that are available within or near the municipalities of the Salinas and Guayama are summarized in table 4.7.4-1 and illustrated on figure 4.7.4-1. It is likely that additional recreational facilities, not shown on this table or figure, may exist within the Project area.

TABLE 4.7.4-1

Recreational Facilities and Activities in the Vicinity of the Aguirre Offshore GasPort Project

Facility	Approximate Number of Visitors (per month)	Activities	Public Access
JBNERR and Visitor's Center	140	Recreational uses allowed vary between the preservation, conservation, and limited use sectors. The JBNERR Visitor's Center is a public facility that has a small library, historical photos, and an interactive exhibition.	The visitor center is open on weekdays. The most frequent visitors are student groups and community groups.
Central Aguirre Golf Club	280	The course has nine holes and, built in 1928, is the oldest golf course in Puerto Rico. The golf course is managed by the municipality.	There is a fee to play at the public course. It is open every day except Monday.
Punta Pozuelo Beach	160	This beach has gazebos and is a popular sunbathing and kite surfing location.	Access and parking available.
Kayak Trail	20	A kayak trail with 11 interpretive signs will be restored in Mar Negro with land access through the Las Mareas community. The kayak tours have been coordinated by the Sierra Club. At present, the DNER has denied permits for kayaking.	Rental kayaks are available from the community organization.
La Paseadora	600	Tour company that offers snorkeling tours, a trip around Jobos Bay, and a trip to Cayo Ratones (also known as Cayo Matías) for a beach day.	Trips are offered on weekends and holidays.
Guayama Kite Crew School and Tropical Kiteboarding	7	Kite surfing classes from Punta Pozuelo Beach. The kite surfers use the area off of Pozuelo Beach, Cayos Caribes, Cayos de Barca, and Boca del Infierno pass.	A fee is required for classes.
Aqua Adventure	50	Aqua Adventure has facilities in Guanica, San Juan, and Salinas and offers SCUBA, snorkeling, and sightseeing cruises.	Offers a number of options for a fee.
Guayama Nautical Club	Not applicable	Private marina in Punta Pozuelo on Jobos Bay. The Nautical Club has a total capacity for 200 boats [a] with space for vessels both on the water (up to 45 vessels) and in dry dock [b].	Private.
Salinas Marina	Not applicable	Public marina accommodates recreational vessels and offers a public boat ramp. Accommodates 103 vessels. [b] Boat ramp serves 6 to 10 boats per day on weekends [c]	Public boat ramp.

a Source: Pales, 2012
b Source: Puerto Rico Encyclopedia, 2010
c Source: Ortiz et al., 2012

Figure 4.7.4-1
Recreational Uses Proximate to the Project Area
Aguirre Offshore GasPort Project

Recreational Boating

Recreational boating within Jobos Bay and the Project area occurs year-round and includes power boats, kayaks, canoes, and other watercraft. The use of jet skis or similar personal watercraft are prohibited in all areas of the JBNERR (DNER, 2010). Anchoring and mooring in areas around the barrier islands and within Jobos Bay are limited to 3 hours. The DNER plans to designate docking and mooring facilities for public use of Jobos Bay in a manner that will not threaten or significantly disturb the natural ecosystem.

A number of boating facilities are located near Jobos Bay, including but not limited to public and private marinas, public docks and boat launches, fishing clubs, and water taxis. The largest boating facilities in the area are the Salinas Marina and the Guayama Nautical Club. The Salinas Marina is west of the Project area (see figure 4.7.4-1) and has capacity to accommodate 103 vessels (Puerto Rico Encyclopedia, 2010). The Guayama Nautical Club is east of the Project area (see figure 4.7.4-1) and has capacity to accommodate 200 vessels including slips and dry storage (Puerto Rico Encyclopedia, 2010). According to public comments made by residents of Salinas and Guayama, the actual number of recreational boats within and near Jobos Bay on a daily basis is much higher than the capacity of boats that are stored at the private marinas in the Project area, particularly on weekends and holidays.

Public boat ramps are available in Playita de Salinas, Puerto de Jobos, and three locations in Punta Pozuelo in Guayama (see figure 4.7.4-1). Private boat ramps are also located at a number of residences near the Project area. The public and private boats that enter water from the boat ramps near Jobos Bay east of the Project area are likely cross over the proposed pipeline route in order to exit or enter Jobos Bay.

A kayak trail is located within part of the preservation, limited use, and conservation sectors of the JBNERR. The DNER plans to re-route and restore the existing kayak trail for security and public safety reasons, although no date for the trail restoration has been set (DNER, 2010). The newly formed Las Mareas Community non-governmental organization plans to provide kayak rentals and to assist with the restoration of the kayak trail. The kayak trail has not received a permit for operation from the DNER as of June 2014.

Recreational Fishing

Approximately 120,000 residents and between 20,000 and 40,000 non-residents participate in marine recreational fishing each year within Puerto Rico. A variety of fishing methods are used, including hand-line fishing, standard rod and reel, fly fishing, kayak fishing, boat trolling, and skin diving (Sea Grant Puerto Rico, 2012). Recreational anglers target a variety of species, including but not limited to species groups such as barracudas, cartilaginous fishes (e.g., sharks and rays), dolphins, drums, eels, flounders, grunts, herrings, jacks, mullets, porgies, puffers, sea basses, snappers, triggerfish, tunas and mackerals, and wrasses. Fisheries in the Project area are discussed in section 4.5.5.3. The Guayama Nautical Club hosts two sport fishing tournaments each year: The Dorado (mahi mahi) tournament in March and the Wahoo tournament in November. The tournaments typically have between 50 and 100 participating vessels (Pales, 2012).

Fishing of any kind is illegal within the preservation sector of the JBNERR; however, hook and line fishing is allowed within the conservation and limited use sectors (DNER, 2010). Catch and release fishing and releasing small or immature individuals is encouraged by the DNER. Illegal fishing with nets and pots within the JBNERR is occasionally encountered by JBNERR staff (DNER, 2010).

Other Marine-Dependent Activities

Coastal areas of the Municipalities of Salinas and Guayama are used year-round for swimming, scuba diving, snorkeling, and other watersports such as kayaking and kite surfing. Swimming beaches are located at Punta Pozuelo public beach and other private swimming areas near both Cayos de Barca and Cayos Caribes (see figure 4.7.4-1). Punta Pozuelo beach is regularly used for swimming and is also used by the Guayama Kite Crew School and Tropical Kiteboarding. Kite surfing activities take place from Cayos de Barca to an area east of Punta Pozuelo beach (Guayama KiteBoarding School, 2013). In May 2012 and 2013, the Puerto Rico Kite Surfing Federation sponsored a kite surfing tournament at Punta Pozuelo, which is anticipated to occur annually.

Scuba diving and snorkeling trips occur around the coral reefs near Jobos Bay. Linear reefs are present along the seaward and inland sides of Cayos de Barca and Cayos Caribes, which are typical of Caribbean reefs (Field et al., 2003). Aqua Adventures, which operates from Salinas, offers scuba and snorkeling trips at Caja de Muertos Island (located approximately 18 miles [29 km] west of the Project area) and planned to offer scuba and snorkeling trips along the reefs within Jobos Bay starting in summer 2013. However, as of June 2014, Aqua Adventures and other commercial scuba and snorkeling outfitters have not offered regular scuba or snorkeling trips within Jobos Bay.

In addition to swimming and scuba, visitors at the JBNERR commonly participate in wildlife viewing; however, it is unknown how many of the approximately 140 monthly visitors come specifically to see wildlife. Near the Project area, Cayos Caribes has a marked walking trail, observation tower, and a small pier that are often used for wildlife viewing.

4.7.5 Commercial Fishing

Commercial fisheries in Puerto Rico are generally small-scale and are predominately operated-owned with low capital investment. Currently, there are approximately 800 to 1,000 licensed commercial fishers, island wide. However, according to public comments made by residents of Salinas and Guayama, obtaining a commercial fishing license from the DNER is difficult and therefore there are many unlicensed commercial fishers. Both licensed and unlicensed commercial fishing in Guayama and Salinas is comprised of multi-gear fishing for a variety of species in both inshore and offshore. The location (i.e., inshore or offshore) of fishing activities and the target species are dependent on the season and the weather; however, local residents commented that all areas in and around Jobos Bay are fished. Many commercial fishers in Guayama and Salinas use homemade boats with outboard motors, called yolas, which typically range between 10 and 25 feet (3 to 8 m) in length (Garcia-Quijano, 2009).

The DNER Fisheries Research Laboratory recognizes a total of 88 fishing centers in 42 coastal municipalities around Puerto Rico, including the islands of Vieques and Culebra (DNER, 2007). Six of these centers are within 5 miles (8 km) of the Project area including the Playa, Playita, Las Mareas, and Aguirre fishing villages in Salinas and Puerto de Jobos, and Punta Pozuelo fishing villages in Guayama (see figure 4.7.5-1). Recreational and subsistence fishing also occur in these areas.

According to an interview with Miguel Ortiz, President of the Punta Pozuelo Fisherman Village, fishermen are scattered around Jobos Bay; however, the Punta Pozuelo Fisherman Village is the only certified commercial fishing cooperative in the bay (Ortiz et al., 2012). The Punta Pozuelo Fisherman Village is comprised of 19 individuals who fish near the barrier islands using hand lines, troll lines, long lines, and rod and lines. These fisherman fish near the barrier islands for a variety of species, including grouper, snapper, mojarras, grunts, croakers, white mullet, dolphin fish, and wahoo, depending on the weather and the season.

Figure 4.7.5-1
Fishing Villages Proximate to the Project Area
Aguirre Offshore GasPort Project

4.7.6 Visual Resources

The Project would be located approximately 1 mile (1.6 km) outside of Jobos Bay and approximately 3 miles (4.8 km) from the mainland shore. The Project area has ocean to the south and is framed by multiple cay islands and mainland Puerto Rico to the north. The mainland landscape is comprised of mixed-use seaside communities, agricultural lands, and open land. Various private beaches, public boat ramps, the JBNERR, and other recreational areas are found along the shoreline where residents and tourists come to recreate and enjoy views of Jobos Bay and the ocean. Marinas and commercial areas, including the Aguirre Plant, are also present. The landscape along the immediate coastline consists of cay islands and mainland areas with mangrove forests and beaches, while the area surrounding Jobos Bay is part of the coastal plain subtropical dry forest with scrub-shrub and forested habitats (DNER, 2010). Topography varies from broad flat beaches along the immediate coast and increases in elevation heading inland. Views from coastal communities show the barrier islands and relatively unobstructed views of the ocean and the horizon.

4.7.7 General Impact and Mitigation

Construction of the Project facilities would require the use of a variety of vessels including lay barges, dive support vessels, support tugs, crew boats, pipe transport barges, and pipe haul barge tugs. The presence of these vessels would represent an increase in the current levels of large vessel traffic in the bay, which is typically limited to small recreation and commercial fishing vessels. The barges that deliver fuel oil to the Aguirre Plant utilize the dredged ship navigation channel to the west of the Project and would not likely be impacted by construction activities. Aguirre LLC would coordinate with the fuel oil delivery vessel operators to provide uninterrupted access to the Aguirre Plant. The remaining shipping vessel traffic discussed above would be located outside of Jobos Bay and would not likely be impacted by the construction of the offshore berthing platform due to the open sea available to the south.

Pipeline construction would disturb approximately 14.0 acres (14.4 cuerdas) of the JBNERR conservation sector, of which 0.2 acres (0.2 cuerdas) would be permanently impacted on the seafloor. If an HDD under Boca del Infierno pass was utilized (see recommendation in section 3.6), the required construction workspace in the conservation sector would be larger. However, the HDD construction method would reduce the amount of pipeline laying on the seafloor and would thereby reduce the permanent footprint in the conservation sector. Based on the limited impacts in this area and a review of the management plan for the Reserve (DNER, 2010), we do not anticipate any significant impacts on the use or management of the JBNERR, regardless of whether the pipeline in this area is constructed by direct lay or HDD.

Construction activities could interfere with recreational boating and fishing in the area due to increased vessel traffic in and around Jobos Bay. Construction activities could also interfere with some commercial fishing sites and vessels in transit to fishing sites due to exclusion from active construction sites. However, restrictions on boating during construction would only occur around the construction equipment, which would be a short duration in any one area as the construction activities moves through the Jobos Bay area. It is anticipated that commercial and recreational vessel operators would have the ability to safely navigate and avoid construction activities. The temporary impact of the Project is 129.9 acres (133.7 cuerdas), which is relatively small in comparison to the total area of Jobos Bay and the open ocean areas that are used as fishing areas. As noted above, all areas in and around Jobos Bay are used for fishing; therefore, there are abundant areas to fish near the Project area that would not be restricted during construction or operation of the Project. To ensure that construction impacts on boating and fishing are minimized during construction, **we recommend that:**

- **<u>Prior to construction</u>, Aguirre LLC should file with the Secretary a Construction Access Plan that clarifies all areas that it will restrict to marine users, clarifies the**

duration of any restriction, and identifies the methods of communication of restrictions to the general public.

Based on the limited footprint of the proposed construction activities and the availability of adjacent fishing areas, as well as our recommendation, we conclude that construction and operation of the Project is not likely to cause a significant impact on boating and fishing in the area.

The Comité Diálogo Ambiental ("Environmental Dialog Committee") commented that subsistence fishing does occur in the Project area. However, as mentioned previously, construction activities would only limit fishing near the construction equipment and there are other known fishing areas outside of the Project area that would not have limited access during construction or operation of the Project. Given the limited scope of the Project and the relatively small construction and operational footprint of the pipeline in and around Jobos Bay, we anticipate that the effects to subsistence fishermen from Project activities would be minor and short-term. The Comité Diálogo Ambiental also commented that it is concerned about the Project construction having long-term impacts on fishers in the area due to habitat destruction. Potential impacts on fisheries resources in the Project area are discussed in section 4.5.5.4.

Operation of the Project would have minor direct impacts on the boating, fishing, and other marine uses in the Jobos Bay area as well as around the FSRU and LNG carriers. The USCG LOR Analysis (appendix B, section 1) advises posting the subsea pipeline area on NOAA navigational charts to inform mariners of the submerged pipeline and noting it as a risk for anchoring as well as a risk with vessels with a deep draft. However, much of Jobos Bay contains shallow water that is less than 20 feet (6 m) deep, which limits navigation of vessels with a deep draft. The pipeline would be buried with at least 3 feet (0.9 m) of ground cover in areas with a water depth less than 12 feet (3.6 m) and buried to grade along most of the rest of the route (see section 2.3.4). Boat travel over the pipeline would not be restricted during operation of the Project. Therefore, the pipeline is not anticipated to have a significant impact on the operation of vessels within Jobos Bay.

The USCG LOR Analysis recommends placement of a safety zone of 500 yards (457 m) around the platform and a moving 100-yard (92 m) safety zone for LNG carriers while on approach and departure to the Offshore GasPort. The approach of LNG carriers to the Offshore GasPort would be coordinated with the USCG. The safety zone is discussed in more detail in section 4.11. Recreational and commercial vessels would not be able to enter the safety zone without permission from the COTP. Although this safety zone would essentially preclude boating, fishing, and other marine uses within 500 yards (457 m) of the Offshore GasPort and 100 yards (92 m) of a moving LNG carrier, we do not anticipate significant impacts on recreational, commercial, or subsistence uses in the larger area surrounding Jobos Bay. Similarly, the impacts on coastal recreation, such as hiking or sunbathing and other onshore activities, are anticipated to be minimal.

Aguirre LLC conducted a visual assessment from three locations proximate to the Project area including Highway 53 in Guayama (6 miles [10 km] northeast), the Salinas Marina Inlet (4.5 miles [7.2 km] northwest), and a lookout tower on Cayos Caribes (1.5 mile [2.4 km] northeast; see figure 4.7.7-1). Figures 4.7.7-2 through 4.7.7-4 show the existing and simulated views of the Project area from these locations as provided by Aguirre LLC.

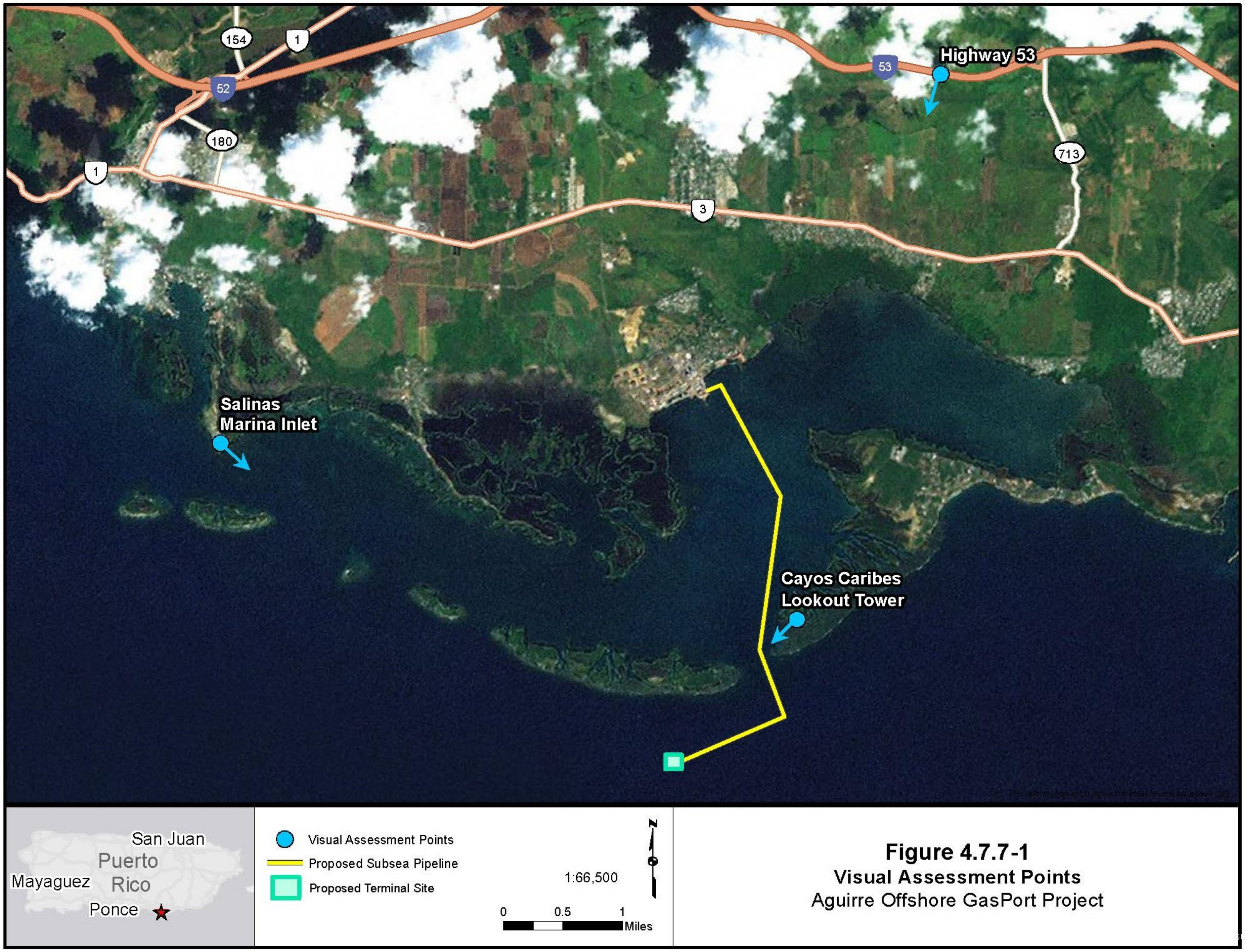


Figure 4.7.7-1
Visual Assessment Points
Aguirre Offshore GasPort Project

Figure 4.7.7-2
Visual Assessment from Highway 53
Aguirre Offshore GasPort Project

Figure 4.7.7-3
Visual Assessment from Salinas Marina Inlet
Aguirre Offshore GasPort Project

Figure 4.7.7-4
Visual Assessment from Cayos Caribes Lookout Tower
Aguirre Offshore GasPort Project

As shown on figures 4.7.7-2 and 4.7.7-4, the FSRU is apparent from the upland highway viewpoint and it dominates the view from the Cayos Caribe lookout tower. The presence of the FSRU would visually affect wildlife viewing from the Cayos Caribe lookout tower and other places within the JBNERR that have views of the ocean. As shown on figure 4.7.7-4, the red FSRU contrasts the blue and green landscape that surrounds the Project area. The FSRU is less apparent from the Marina de Salinas, as the barrier islands partially obstruct the line of sight. Views of Jobos Bay and the ocean south of Jobos Bay include daily recreational and commercial fishing boats, and occasionally include LNG vessels or other ocean-going barges.

Visual impacts on the Project area from fuel oil barges would decrease after construction of the Project. Currently, 8 to 10 fuel oil or oceangoing barges pass south of Jobos Bay each week, and 3 to 4 fuel oil barges enter Jobos Bay each week. During operation of the Project, the frequency of fuel oil barge traffic within Jobos Bay is anticipated to decrease to one barge per week. The reduction in fuel oil barges would allow users of the Jobos Bay area to view a more natural environment.

The Offshore GasPort would be lit 24 hours per day by security lighting, navigation lights, and Federal Aviation Administration warning lights. The waters surrounding the Offshore GasPort are unlit due to the lack of permanent structures in the water and on uninhabited Cayos Barca and Cayos Caribe. Therefore, the nighttime lighting contrast between the Project and the background would be high. To date, Aguirre LLC has not provided any simulations of the nighttime lighting in the Project area. We are recommending in section 4.5.3.3 that Aguirre LLC develop a lighting plan that identifies specific measures that would be implemented to minimize or avoid impacts associated with nighttime lighting.

4.8 SOCIOECONOMICS

This section describes the socioeconomic resources that could be affected by the construction and operation of the proposed Project. We also present our analysis of commercial fishing, marine recreation and tourism, onshore socioeconomic conditions, and environmental justice.

The Project area considered in this EIS for socioeconomic resources (referenced as "socioeconomic region") includes the municipalities and towns and ports along the shoreline of Guayama and Salinas, which are the two municipalities located to the east and west of the Project area. The community of Central Aguirre is within the municipality of Salinas, and is included in the economic statistics for Salinas when community-specific data were not available.

4.8.1 Existing Socioeconomic Conditions

4.8.1.1 Population and Housing

The population within the Project's socioeconomic region accounts for approximately 2 percent of Puerto Rico's population. The latest population estimates from the U.S. Census Bureau show that the populations of the municipalities of Salinas and Guayama have declined by less than 1 percent since the 2010 Census (U.S. Census Bureau, 2012). The census data also show that the socioeconomic region is largely comprised of a Puerto Rican population, with Central Aguirre having the largest non-Puerto Rican population of 2.1 percent. Central Aguirre has the highest population density, which is likely due to the land area only including the Aguirre population center and not the rural areas that surround Central Aguirre, while the populations of Salinas and Guayama include both urban and rural areas. Table 4.8.1-1 summarizes the population data and housing occupancy and vacancy numbers for each municipality and the community of Aguirre.

TABLE 4.8.1-1

Summary of Population and Housing Conditions in Aguirre, Salinas, and Guayama

Category	Unit	Central Aguirre	Salinas	Guayama
Land Area	Square mile (km^2)	0.5 (1.3)	69.7 (180.5)	65.0 (168.3)
Total Population	Persons	1,263	31,019	45,250
Population Density	Persons per square mile (km^2)	2,526 (972)	445 (172)	696 (269)
Occupied Housing Units	Number	429	11,400	16,244
Vacant Housing Unit	Number	142	2,980	3,467
Rental Vacancy Rate	Percent	0.0	3.6	7.1

Sources: U.S. Census Bureau, 2010a and 2012

4.8.1.2 Employment and Unemployment

The employment rate within the Project's socioeconomic region varies within Central Aguirre, Salinas, and Guayama. Central Aguirre has a higher unemployment rate than Salinas and Guayama, as well as having the lowest mean household income (U.S. Census Bureau, 2010a). Jobs within Central Aguirre are mainly in production, transportation, and material moving, which employs approximately 39.3 percent of the employed civilian workforce. This sector only employs 18.1 and 14.1 percent of the workforce in Salinas and Guayama, respectively. The service sector employs the highest percent of the employed workforce in Salinas, and the management, business, science, and arts sector employs the highest percent of the employed workforce in Guayama. Table 4.8.1-2 summarizes the employment data for each municipality and the community of Aguirre.

TABLE 4.8.1-2

Summary of Employment Statistics in Aguirre, Salinas, and Guayama

	Unit	Central Aguirre	Salinas	Guayama
Civilian Labor Force Unemployment Rates	Percent	35.5	23.1	21.4
Mean Household Income	Dollars	21,725	20,650	25,202
Per capita personal income	Dollars	7,594	7,517	9,020
Employment Data				
Management, business, science, and arts	Persons	28	1,786	3,443
Service	Persons	65	2,009	2,413
Sales and office	Persons	7	1,343	3,538
Natural resources, construction, and maintenance	Persons	16	1,323	1,373
Production, transportation, and material moving	Persons	129	1,193	1,468

Sources: U.S. Census Bureau, 2010a and 2012

According to Aguirre LLC, construction of the Project is anticipated to require approximately 350 workers over a 12-month construction period. Aguirre LLC did not provide an exact estimate of local workers that would be hired for construction; however, Aguirre LLC has stated it intends to hire at least 10 percent of the construction workforce locally (approximately 35 workers). Aguirre LLC has not specified if workers used during the construction of the Project would be from Central Aguirre, Salinas, or Guayama, as hiring would be dependent on the availability and capability of the local workforce.

Aguirre LLC also anticipates that approximately 13 to 15 skilled personnel would be required for the operation of the Project. These positions would include a terminal manager, assistant manager, jetty operators, and security personnel. The hiring of local workers to fill these positions is dependent on the availability of specialized workers. In addition, Aguirre LLC plans to use escort and barge tugs to support operations that are currently located in Puerto Rico, although no estimates of workers to operate the tugs were provided.

The workers at the Aguirre Plant would be trained to continue operation at the Aguirre Plant after the fuel source is converted. These workers would likely maintain their current employment status during construction and operation of the Project. If, however, the fuel source at the Aguirre Plant is not converted and operation of the Aguirre Plant is reduced or ceased in order to meet current air emissions standards, then employment at the Aguirre Plant could potentially be reduced and unemployment numbers within Aguirre, Salinas, and Guayama could be negatively impacted.

A public comment was received that expressed concern that the number of proposed jobs to be created by the Project by Aguirre LLC is inaccurate. Aguirre LLC signed an affidavit that ensures that the information provided to FERC is true and provides the best available information. Therefore, we assume that the number of jobs created by the Project and given to local members of the community to be accurate.

4.8.1.3 Income

As shown in table 4.8.1-2, the mean household income and the per capita personal income are lower in Salinas than in Aguirre and Guayama, while Guayama had the highest mean household and per capita income levels (U.S. Census Bureau, 2012). Aguirre LLC did not provide income estimates for local workers to be hired during construction of the Project, although based upon average incomes for construction occupations within the Project area, approximately 35 local workers would receive an estimated income between $12,650 and $17,500 based on median incomes during construction (U.S. Census Bureau, 2010b). Operation of the Project is anticipated to generate annual mean income that ranges from $87,000 for the terminal manager to $24,000 for administrative assistants. Maintenance, security, and jetty operator positions are anticipated to generate annual mean income of $34,000, $31,000, and $37,000, respectively. Based on the 2010 census data, management occupations in Salinas and Guayama had a median annual income of $32,022 and $26,794, respectively. Protective service occupations in Salinas and Guayama had median annual incomes of $24,167 and $22,611, respectively (U.S. Census Bureau, 2012). Therefore, the mean annual incomes for the operational positions required for Project are anticipated to be higher than the median incomes for similar positions in the Project area (see figure 4.8.1-1).

4.8.1.4 Taxes

Income tax rates within Puerto Rico vary based on the source of income (i.e., income from Puerto Rico or U.S. mainland). Puerto Ricans, unless they are federal employees or earn income that was generated on the mainland of the United States, are not required to pay federal income taxes (Internal Revenue Service, 2013). As such, Aguirre LLC estimates that the Commonwealth of Puerto Rico would be paid approximately $580,000 of annual income tax revenue during operation of the Project. Aguirre LLC did not provide an estimate of annual tax revenue during construction; however, the estimated average median income for construction workers in the area ranges between $12,650 and $17,500, which would be taxed at the Puerto Rico income tax rate which varies between 7 and 33 percent, depending on total annual income.

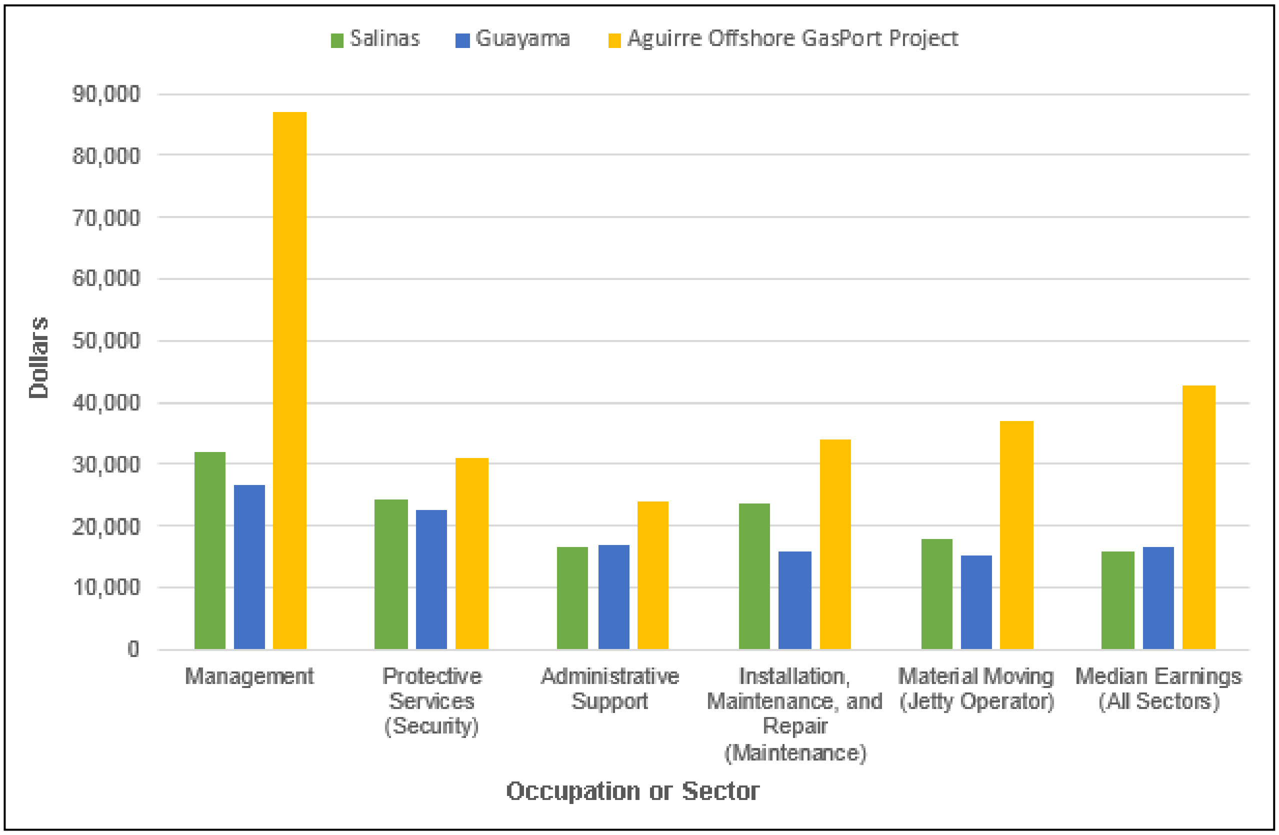


Figure 4.8.1-1 Median Income Within the Project Area by Occupation/Economic Sector
Source: U.S. Census Bureau, 2012

4.8.2 Environmental Justice

This section presents the demographic data to identify potential environmental justice impacts associated with the Project. An area is considered to have a disproportionately high percentage of low-income or minority residents under either of two conditions:

1. if the percentage of low-income or minority populations within that area is substantially greater than the county or state low-income or minority percentage, or

2. the percentage of persons in low-income or minority populations within the area is greater than 50 percent.

In accordance with Executive Order 12898 on Environmental Justice, all public documents, notices, and meetings were made readily available to the public throughout the Project area during our review of the Project. The mailing list for the Project has been continuously updated during the EIS process. Section 1.4 of this EIS further describes the public participation and notification processes.

Within Puerto Rico, approximately 99 percent of the population is Hispanic or Latino, and approximately 95.4 percent of the Hispanics or Latinos report to be Puerto Rican (U.S. Census Bureau, 2010b). The socioeconomic region has a Puerto Rican percentage of the population that is higher than the island-wide average. However, the socioeconomic region (specifically, Central Aguirre) has substantially lower mean household and per capita income, and substantially higher percentages of families below the poverty line. Unemployment within Central Aguirre is more than double that of the average in Puerto Rico. In addition, all other poverty data in Central Aguirre and Salinas were substantially higher than in Puerto Rico as a whole. Poverty indicators in Guayama are similar to those of Puerto Rico as a whole; however, the unemployment rate is substantially higher and mean household income is substantially lower in Guayama than overall in Puerto Rico. Table 4.8.2-1 summarizes the income and poverty data for the socioeconomic region and Puerto Rico as a whole.

TABLE 4.8.2-1

Poverty Statistics for Aguirre, Salinas, Guayama, and Puerto Rico

Category	Unit	Central Aguirre	Salinas	Guayama	Puerto Rico
Mean household income	Dollars	21,725	20,650	25,202	30,270
Per capita personal income	Dollars	7,594	7,517	9,020	10,850
Civilian labor force unemployment rates	Percent	35.5	23.1	21.4	17.8
People below the poverty line	Percent	51.0	59.5	47.5	45.1
Families below the poverty line	Percent	45.3	55.4	44.2	41.2
Families below the poverty line with related children under 5 years old	Percent	40.6	62.8	63.9	50.5
Families with female householder, no husband present, below the poverty line	Percent	81.7 [a]	65.1 [b]	59.4 [c]	58.1 [d]

Sources: U.S. Census Bureau, 2010a and 2012

[a] In Central Aguirre, 23.8 percent of households have a female householder with no husband present.

[b] In Salinas, 23.4 percent of households have a female householder with no husband present.

[c] In Guayama, 24.4 percent of households have a female householder with no husband present.

[d] In Puerto Rico overall, 22.6 percent of households have a female householder with no husband present.

4.8.3 Commercial Fisheries

Commercial fishing in Puerto Rico has been in decline since the middle of the 1980s, and declines in total catch have continued in recent years. Between 2007 and 2010 commercial fishing declined in Puerto Rico due to a number of factors, including overfishing, fewer active commercial fishermen, the economic recession, higher gas prices, and implementation of stricter fishing regulations by the DNER. Total reported landings within Puerto Rico declined from approximately 1.24 million pounds (562,500 kg) in 2007 to approximately 1.11 million pounds (499,000 kg) in 2010 (Matos-Caraballo et al., 2011). Information regarding the total landings located specifically within the municipalities of Guayama and Salinas was not readily available.

According to Puerto Rico Law 278 of November 29, 1998, which is known as Puerto Rico's Fishing Law, a full-time commercial fisher is a person that receives 50 percent or more of his/her income from fishing activity, while a part-time commercial fisher receives between 49 and 20 percent of his/her income from fishing activity. In accordance with the Puerto Rico Fishing Law, full-time and part-time fishermen must submit their income to the Internal Revenue Service in order to receive a commercial fisher license. However, many fishermen do not obtain a commercial fishing license because they do not want to file income taxes or complete monthly sales tax reports for their fishing income (Matos-Caraballo and Agar, 2011). Table 4.8.3-1 summarizes the number of commercial fishermen in Puerto Rico by percentage of income from fishing activity based on information obtained from both licensed and unlicensed commercial fishermen, as collected by NMFS and the Commercial Fisheries Statistics Program of the DNER (Matos-Caraballo et al., 2011). As shown in table 4.8.3-1, approximately 88 percent of active commercial fishermen on the southern coast could be considered full time.

TABLE 4.8.3-1

Number of Commercial Fishermen by Percentage of Income Generated by Fishing Activity Within Puerto Rico

Location	Number of Fishermen	Percentage of Income from Fishing			
		100-75	74-50	49-20	Less than 20
North Coast	162	45	48	43	26
East Coast	155	91	17	26	45
South Coast	233	139	65	16	15
West Coast	318	230	62	18	15
TOTAL	**868**	**505**	**192**	**103**	**101**

Source: Matos-Caraballo and Agar, 2011

As of 2008, an estimated 868 commercial fishermen were active in Puerto Rico, including 51 fishermen in the Guayama and Salinas area (see table 4.8.3-2). This total was down approximately 295 fishermen from 2002 (Matos-Caraballo and Agar, 2011). The total number of commercial fishermen within the Project area since 2008 is not available. Based upon the comments of local fishers, the current number of commercial fishers is likely higher than those summarized below. There are six fishing villages managed by the Puerto Rico Department of Agriculture within 5 miles (8 km) of the Project area (see section 4.7.5).

TABLE 4.8.3-2

Number of Commercial Fishermen Within Guayama and Salinas

Municipality	Full Time [a]	Part Time [b]	Average Age (years)
Guayama	11	4	39
Salinas	25	11	55

Source: Matos-Caraballo and Agar, 2011

[a] Full time is defined as a person who earns 50 percent or more of his/her income from fishing activities.

[b] Part time is defined as a person who earns between 49 and 20 percent of his/her income from fishing activities.

4.8.4 Tourism and Coastal Recreation

Tourism plays a significant role in the Puerto Rican economy. In 2005, Puerto Rico drew approximately 3,686,000 visitors, which contributed approximately $3.2 billion to the Commonwealth's economy (NationMaster, 2013). In addition to contributing to Puerto Rico's economy, tourism supports thousands of jobs. In May 2013, Puerto Rico had approximately 75,500 jobs in leisure and hospitality (Bureau of Labor Statistics, 2013a). In 2012, leisure and hospitality workers in Salinas and Guayama had average annual salaries of $11,266 and $11,490, respectively (Bureau of Labor Statistics, 2013b). Leisure and hospitality labor statistics specifically for Central Aguirre are not available.

Coastal recreation in Salinas and Guayama includes boating, fishing, wildlife viewing, kayaking, diving, golf, and swimming/sunbathing at beaches (see section 4.7.4). Estimates of recreational fishing harvests were prepared by the DNER Marine Recreational Fisheries Statistics Program in collaboration with NMFS from 2000 to 2013. Starting in 2014, they are being prepared solely by NMFS. According to NMFS, the total recreational fishing harvest in Puerto Rico has been generally declining from 2002 to 2012 (see table 4.8.4-1), in part due to emigration effects, increasing popularity of catch and release, and also ongoing overharvest of the resource. Approximately 120,000 residents and between 20,000 and 40,000 non-residents participate in marine recreational fishing each year in Puerto Rico. These anglers contributed over $72,400,000 into the local economy in 2011 in direct purchases alone (Lovell et al., 2013).

TABLE 4.8.4-1

Total Harvest of Recreational Fisheries for Puerto Rico (2002 to 2012)

Year	Total Harvest (number of fish)	Total Harvest (pounds) [kilograms]
2002	1,266,495	2,454,351 (1,113,275)
2003	1,527,092	3,767,579 (1,708,945)
2004	870,977	2,149,865 (975,162)
2005	923,948	1,973,897 (895,345)
2006	664,881	2,402,422 (1,089,720)
2007	1,067,644	2,375,686 (1,077,593)
2008	1,341,256	1,911,312 (866,957)
2009	663,593	1,166,187 (528,974)
2010	392,623	784,068 (355,647)
2011	387,306	891,662 (404,451)
2012	477,678	1,245,676 (565,029)

Source: NMFS, 2013a

4.8.5 General Impact and Mitigation

The construction and operation of the Project would have minor impacts on the existing socioeconomic conditions within the Project area. Potential impacts on populations could arise due to incoming workers associated with the Project. However, these impacts would be localized and temporary and would be limited to the influx of non-local workers and their family members.

The construction and operation of the Project is not anticipated to have an effect on rental and occupancy rates. Construction workers would be housed onboard the construction barges, and post-construction population levels in the Project area are expected to remain consistent with pre-construction levels, as the number of workers required to operate the facility would require only a minimal number of local employees. As the Project construction and operational activities would occur mainly offshore, the Project is not anticipated to have a noticeable effect on local infrastructure such as schools, fire and police departments, and medical facilities. Temporary and permanent hires would increase tax revenue in the area and may lower unemployment rates within the local communities proximate to the Project site.

A public comment was received stating that the U.S. Census Bureau socioeconomic data for the Project area were not sufficient to complete a socioeconomic analysis of Project impacts. We believe that the U.S. Census Bureau data are the best available data, and do provide sufficient information to appropriately analyze the socioeconomic impacts of the Project. We also received a comment that economic data for commercial fishing, tourism, and tax revenues specifically for Salinas and Guayama, in addition to the U.S. Census Bureau data, should be used. These data were not readily available due to a lack of government records or other independent research on these economic indicators, as well as the difficulty of tracking the number of unregistered commercial fishers and workers associated with tourism within the Project area. However, as construction and operation of the Project is anticipated to cause only minor and short-term impacts on commercial fishers, tourism, and tax revenues, it was determined that these specific economic data were not necessary to appropriately analyze the Project impacts.

We conclude that implementation of the Project would not result in any disproportionately high and adverse human health or environmental effects on minority or low-income communities. Guayama and Salinas have higher poverty indicators than the average for Puerto Rico; however, construction of the Project would create some short-term and long-term jobs, in addition to helping retain the jobs at the Aguirre Plant that currently exist. The Project is anticipated to create approximately 35 local jobs during construction, as well as require hiring 13 to 15 skilled personnel for operation. The median income for the jobs created during construction and operation of the Project would be higher than the median income of jobs in similar sectors currently in the Project area. In addition, conversion of the Aguirre Plant to natural gas would allow for the Aguirre Plant to remain in operation, and therefore help with the long-term job security of Aguirre Plant employees that live in Salinas and Guayama. During the construction of the Project, local tax revenue and income to local businesses are anticipated to have a minor increase due to spending by construction workers in the area. In addition to these economic factors, the Project would result in improved air quality by converting the fuel for the Aguirre Plant to natural gas. The surrounding communities to the Aguirre Plant currently experience emissions from the fuel oil burned at the plant. Therefore, the conversion to natural gas would benefit this low-income community.

Construction activities would have the potential to interfere with some commercial fishing sites and vessels in transit to fishing sites due to safety zone exclusions from active construction sites. However, consultations with commercial fishers in Salinas and Guayama provided by Aguirre LLC and comments made by local fishers at public comment meetings state that commercial fishing occurs throughout Jobos Bay and the surrounding open ocean. Construction activities could also temporarily interfere with recreational boating and fishing in the area due to increased vessel traffic in and around Jobos Bay. Based on the limited footprint of the proposed construction activities, it is anticipated that commercial and recreational vessel operators would have the ability to safely navigate and avoid construction activities.

In addition to the potential impacts on commercial and recreational fishing and boating, construction and operation of the Project may affect subsistence fishermen in the area. The Comité Diálogo Ambiental commented that subsistence fishing does occur within the Project area. As mentioned previously, construction activities would limit subsistence fishing near the construction areas and vessels in transit to fishing sites due to exclusion from active construction sites. However, given that there are alternative fishing areas that could be accessed during construction, there is a relatively small construction and operational footprint of the pipeline in and around Jobos Bay, and we are recommending in section 4.7.7 that access through the Boca del Infierno pass and within Jobos Bay be maintained throughout the construction process, we anticipate that these effects would be minor and short-term.

The Mayor of Salinas, Ms. Karilyn Bonilla, expressed concerns about impacts on tourism in the area stating that the growth of tourism is seen as a way to improve the economic conditions of Salinas and Guayama. She also stated that Salinas and Guayama do not have traditional beaches on the mainland shoreline; rather, tourists use the sand beaches along the cays for recreation purposes. The construction and operation of the Project would result in visual and noise impacts on the areas proximate to the Project, including the cays (see section 4.7.7 and 4.10.2). The operation of the Offshore GasPort would result in permanent impacts on fishers who use the area. In addition, the visual impact of the facility may make the eastern side of the cays less appealing to tourists. The regional area, however, has other areas available that are comparable for recreation and fishing; thus, it is determined to be a minor impact on the resources.

Operation of the Project would have direct minor impacts on the boating, fishing, and other marine uses in the Jobos Bay area as well around the FSRU and LNG carriers. The USCG LOR Analysis (appendix B, section 1) describes and recommends measures that would include posting the subsea pipeline area on NOAA navigational charts informing mariners of the submerged pipeline and noting it as a risk for anchoring as well as a risk with vessels with a deep draft. In addition, the USCG LOR Analysis recommends a safety zone of 500 yards (457 m) around the platform and a moving 100-yards (92 m) safety zone for all LNG carriers entering the surrounding areas of Jobos Bay while on approach and departure to the Offshore GasPort. The safety zone is discussed in more detail in section 4.11. Recreational and commercial vessels would not be able to enter the safety zone without permission from the COTP. This safety zone would essentially preclude boating, fishing, and other marine uses in the area. Boating, fishing, and other marine uses would experience direct but minor impacts due to the operations of the Project.

4.9 CULTURAL RESOURCES

Cultural resources include all buildings, sites, districts, structures, features, objects, or landscapes that have been created by or associated with humans and are considered to have historical or cultural value (National Park Service, 1998). Section 106 of the NHPA, as amended (16 USC 470-470t), requires federal agencies to take into account the effects of their undertakings (including authorizations under Section 3 of the NGA) on cultural resources listed or eligible for listing in the NHPA and to afford the ACHP the opportunity to comment on the undertaking. In Puerto Rico, the Institute of Puerto Rican Culture serves as the SHPO. Aguirre LLC, as a non-federal party, is assisting the FERC in meeting its obligations under Section 106 by preparing the necessary information, analyses, and recommendations as authorized by 36 CFR 800.2(a)(3). As a part of the Federal Consistency evaluation, the PRPB will consult the Puerto Rico Culture Institute and request its comments and endorsement according to its responsibilities in the administration of enforceable CZMP policies.

The Area of Potential Effects (APE) for the onshore portion of the Project would occur within the existing fenced Aguirre Plant property. The Project proposes to disturb a small upland portion (approximately 1.5 acres [1.5 cuerdas]) of the industrial site during the construction of the onshore receiving facility and utilization of the temporary construction staging and support area. The offshore construction would include the construction right-of-way and temporary workspace for the 4.0-mile-long (6.4 km) subsea pipeline and the construction area for the Offshore GasPort. The marine survey for the Project encompassed these areas.

Aguirre LLC conducted archival research and marine surveys of the proposed Project area to identify cultural resources including locations for potential prehistoric and historic archaeological sites.

4.9.1 Archival Research

A database review was conducted at the SHPO and Institute of Puerto Rican Culture to identify previously recorded archaeological and architectural resources eligible for listing or listed in the NRHP within both the terrestrial and marine portions of the Project area. The archival research for the terrestrial portion of the Project included a 1-mile (1.6 km) radius of the existing fenced Aguirre Plant property. No sites were identified within the APE. The NRHP-listed Central Aguirre Historic District is located outside of the Project area but within the viewshed of the Project.

Archival research for the underwater portion of the Project included a database review at the SHPO and Institute of Puerto Rican Culture to identify previously recorded submerged resources eligible for listing or listed in the NRHP. The database review indicated that no submerged cultural resources investigations have been conducted within the study area. Nor have any submerged resources been previously documented. Additional sources were reviewed to identify possible wrecks or obstructions within the study area, including NOAA's National Ocean Service, Automated Wreck and Obstruction Information System and Office of Coast Survey Historical Map and Chart Collection, as well as data gathered through oral interviews. The survey indicated that no previously identified historic shipwrecks would be impacted by the Project.

4.9.2 Cultural Resources Investigations

4.9.2.1 Terrestrial Investigation

Background research documented that the 1.5 acre (1.5 cuerdas) area within the Aguirre Plant property has been disturbed as a result of past construction activities and modern shoreline filling. Aguirre LLC did not conduct an archeological survey because of the low potential for intact cultural deposits. In a letter dated August 15, 2012, the SHPO concurred that no archaeological survey is necessary. We concur as well.

The Central Aguirre Historic District is approximately 500 feet (152 m) northeast of the Project area. The Central Aguirre Historic District, constructed by the Central Aguirre Sugar Company between 1899 and 1964, represents the only surviving example of an autonomous planned community in Puerto Rico. At the time this historic district was listed in the NRHP, the Aguirre Plant was identified as an element affecting the visual setting of the district (National Park Service, 2002). Aguirre LLC believes that the Project has little potential to further impact the visual setting of the historic district. In an email dated February 7, 2013, the SHPO commented that the Central Aguirre Historic District does not appear to be affected by this undertaking. We concur.

4.9.2.2 Marine Investigation

The marine APE includes about 155 acres (160 cuerdas) of submerged land that could be affected by the construction and operation of the subsea pipeline and the Offshore GasPort. Aguirre conducted an archeological survey of the Project area through remote sensing using a combination of magnetometer, sidescan sonar, single and multi-beam echo sounders, and sub-bottom profiler technologies.

The water depths in the Project area range from 0 feet/meters at the pipeline landfall to a maximum of 70 feet (21 m) near the receiving facility. Because the shoreline at 7,000 years before present was 32 feet (10 m) lower than modern levels, prehistoric archaeological sites could be present above that depth contour. Therefore, the seafloor was mapped to identify those areas, as well as to ensure the towed systems would not damage the seafloor. Only the pipeline corridor within Jobos Bay falls above the 32 feet (10 m) contour. That area was analyzed for landforms or features that could contain prehistoric archaeological sites. Two areas that may represent sediment beds older than 7,000 years before present were identified; however, the data did not indicate that any features indicative of a site were present.

The magnetometer survey transects were closely spaced to facilitate the detection of early historic exploration and colonization vessels since their signatures tend to be small. In an initial survey, 57 magnetic anomalies were identified in the survey area and of these, 10 anomalies were recommended for further evaluation to determine their eligibility for listing in the NRHP. An addendum survey was performed for a route change, and an additional anomaly was identified for further evaluation. In a letter dated October 3, 2012, the SHPO concurred with the recommendations and strategy for evaluative testing of the anomalies.

Aguirre LLC completed the evaluative testing in March 2013, prepared a report of findings in April 2013, and submitted a copy to the SHPO for review in June 2013. The archaeological assessment of these 11 anomalies determined that they are modern marine debris and therefore are not recommended eligible for listing in the NRHP. In a letter dated July 2, 2013, the SHPO concurred that none of the anomalies were historically significant and that no further archeological work was required. We concur as well.

4.9.3 Unanticipated Discoveries

Aguirre LLC prepared a plan to be used in the event any unanticipated terrestrial or submerged historic properties or human remains are encountered during construction. The plan provides for the notification of the SHPO in the event of any discovery. The SHPO provided comments and requested changes to the plan on October 3, 2012. Aguirre LLC revised the plan in June 2013 to address the SHPO's comments (see appendix F). We approve the plan.

4.9.4 Cultural Resources Consultations

Aguirre LLC consulted with the SHPO between July 2012 and February 2013 concerning the definition of the APE, evaluation of NRHP eligibility, assessment of Project effects, and cultural groups that have designated Traditional Cultural Properties that could be affected by the Project. No Indian tribes with historic ties to the Project area were identified. Additionally, no known Traditional Cultural Properties are within the Project area.

4.9.5 General Impact and Mitigation

Based on the investigations conducted by Aguirre LLC, the comments received from the SHPO, and implementation of Aguirre LLC's unanticipated discoveries plan, we conclude that the Project would not impact any historical resources and that the FERC has met its responsibility under Section 106 of the NHPA.

4.10 AIR QUALITY AND NOISE

4.10.1 Air Quality

This section describes the potential air quality effects associated with the Project. In addition, existing laws and regulations relevant to air quality are described.

Air quality impacts would also result from the conversion of the Aguirre Plant from fuel oil to natural gas. We discuss the Aguirre Plant emissions and the cumulative air quality impacts of the Project and the Aguirre Plant in section 4.12.2.2.

4.10.1.1 Existing Ambient Air Quality

The CAA, as amended in 1997 and 1990, and codified at 40 CFR 50-99, was enacted by Congress to protect the health and welfare of the public from the adverse effects of air pollution. The CAA directed the EPA to establish National Ambient Air Quality Standards (NAAQS) for certain criteria air pollutants. The EPA has promulgated NAAQS for seven air pollutants, including nitrogen dioxide (NO_2), SO_2, particulate matter (2.5 micrometers or less [$PM_{2.5}$] and 10 micrometers or less [PM_{10}]), CO, ozone, and lead.

In December 2009, EPA updated the definition of air pollution to include six greenhouse gases (GHG) after determining that GHGs in the atmosphere can endanger public health and welfare. The GHGs include CO_2, methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. GHGs can be ranked by their global warming potential (GWP), which is a relative measure of a GHG's ability to absorb solar radiation and its residence time in the atmosphere in comparison to that of CO_2. Thus, CO_2 has a GWP of 1. In comparison, CH_4 has a GWP of 25, and N_2O has a GWP of 298.[12]

The NAAQS include both "primary" and "secondary" standards. The primary standards are intended to protect human health; the secondary standards are intended to protect public welfare from any known or anticipated adverse effects associated with the presence of air pollutants, such as damage to vegetation. The more stringent of the primary or secondary standards are applicable to the evaluation of a proposed project. The NAAQS for various durations of exposure are summarized in table 4.10.1-1. Some states have developed more stringent state ambient air quality standards; Puerto Rico does not have such standards and defers to the NAAQS. The EQB will be responsible for review and issuance of permits for Project stationary sources including location approval, construction and operating permit, and Title V permit, as applicable. EPA Region 2, headquartered in New York City, is responsible for PSD permits and is the review authority of the Title V permit, if applicable. As outlined below, PSD permit requirements are not expected to apply to the Project. The EQB permit will evaluate and incorporate all laws and regulations that ensure the protection of the NAAQS and compliance with all air quality regulations.

In addition to the NAAQS, there are many other federal regulations promulgated by the EPA that could potentially be applicable to the Project. These regulations are described in the following subsections.

Air Quality Control Regions (AQCR) were established by the EPA and local agencies in accordance with Section 107 of the CAA, as a means to implement the CAA and comply with the NAAQS through State Implementation Plans. The AQCRs are intra- and interstate regions such as large metropolitan areas where the improvement of the air quality in one portion of the AQCR requires emission reductions throughout the AQCR. Each AQCR, or portion thereof, is designated as attainment (areas in compliance with the NAAQS), unclassifiable, maintenance, or nonattainment (areas not in compliance with the NAAQS). Areas where the ambient air pollutant concentration is determined to be below the applicable ambient air quality standard are designated attainment. Areas where no data are available are designated unclassifiable and are treated as attainment areas for the purpose of stationary source air permitting. Areas where the ambient air concentration is greater than the applicable ambient air quality standard are designated nonattainment. Areas that have been designated nonattainment but have since demonstrated compliance with the ambient air quality standard(s) are designated maintenance for that pollutant.

[12] On November 29, 2013, the EPA revised GWPs for GHGs to reflect more accurate GWPs from the Intergovernmental Panel for Climate Change Fourth Assessment Report to better characterize the climate impacts of individual GHGs and to ensure continued consistency with other U.S. climate programs, including the Inventory U.S. Greenhouse Gas Emissions and Sinks. More information is available in Volume 78 of the Federal Register, Issue 230.

TABLE 4.10.1-1

National Ambient Air Quality Standards

Pollutant	Averaging Period	Primary Standard	Secondary Standard
SO_2	Annual [a,k]	0.03 ppm (80 μg/m^3)	--
	24-Hour [b,k]	0.14 ppm (365 μg/m^3)	--
	3-Hour [b]	--	0.5 ppm (1300 μg/m^3)
	1-Hour [i,j]	75 ppb (196 μg/m^3)	--
PM_{10}	24-Hour [d]	150 μg/m^3	150 μg/m^3
$PM_{2.5}$	Annual [e]	12.0 μg/m^3	15 μg/m^3
	24-Hour [f]	35 μg/m^3	35 μg/m^3
CO	8- Hour [b]	9 ppm (10,000 μg/m^3)	--
	1- Hour [b]	35 ppm (40,000 μg/m^3)	--
Ozone	8- Hour (2008 Standard) [g]	0.075 ppm (150 μg/m^3)	0.075 ppm (150 μg/m^3)
	8-Hour (1997 Standard) [g,h]	0.08 ppm (157 μg/m^3)	0.08 ppm (157 μg/m^3)
NO_2	Annual [a]	53 ppb (100 μg/m^3)	53 ppb (100 μg/m^3)
	1-Hour [c]	100 ppb (188 μg/m^3)	--
Lead	Rolling 3-month [a]	0.15 μg/m^3	0.15 μg/m^3

[a] Not to be exceeded.
[b] Not to be exceeded more than once per year.
[c] Compliance based on 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area.
[d] Not to be exceeded more than once per year on average over 3 years.
[e] Compliance based on 3-year average of weighted annual mean $PM_{2.5}$ concentrations at community-oriented monitors.
[f] Compliance based on 3-year average of 98th percentile of 24-hour concentrations at each population-oriented monitor within an area.
[g] Compliance based on 3-year average of fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area.
[h] The 1997 8-hour ozone standard and associated implementation rules remain in place as the transition to the 2008 standard occurs.
[i] Compliance based on 3-hear average of 99th percentile of the daily maximum 1-hour average at each monitor within an area.
[j] The 1-hour SO_2 standard was effective as of August 23, 2010.
[k] The 24-hour and annual average primary standards for SO_2 have been revoked but remain in effect until 1 year after attainment designations are made for the 1-hour and 3-hour standards.

Notes: ppm = parts per million by volume; ppb = parts per billion by volume; μg/m^3 = micrograms per cubic meter.

The attainment status designations appear in 40 CFR 81. The area in the vicinity of the Project has been designated as "unclassifiable" or better than national standards for all criteria pollutants. Table 4.10.1-2 lists the attainment status for each designated area in the vicinity of the Project. The EPA AirData Interactive Map tool (EPA, 2014a) was used to locate existing monitoring data near the Project site, and the most recent 3 years of data available are presented in table 4.10.1-3.

The data presented in table 4.10.1-3 demonstrate continued compliance with all NAAQS. In some instances the ambient air quality concentrations differ from those used to represent "background" or "design" air quality values for use with air quality modeling results, in accordance with EPA-recommended modeling procedures, to evaluate projected Project impacts relative to the NAAQS.

TABLE 4.10.1-2 **Attainment Status for the Aguirre Offshore GasPort Project Area**		
Pollutant	Designated Area	Designation
SO_2	Puerto Rico AQCR	Attainment
CO	Commonwealth-wide	Unclassifiable/Attainment
Ozone (8-hour standard)	Commonwealth-wide	Unclassifiable/Attainment
NO_2 (1971 annual standard)	Puerto Rico AQCR	Unclassifiable/Attainment
NO_2 (2010 1-hour standard)	Salinas County	Unclassifiable/Attainment
PM_{10}	Rest of Commonwealth	Unclassifiable/Attainment
$PM_{2.5}$ (Annual NAAQS)	Salinas County	Unclassifiable/Attainment with respect to 15 µg/m^3 standard (EPA expects to designate with respect to the 12 µg/m^3 standard by December 2014)
$PM_{2.5}$ (24-hour NAAQS)	Salinas County	Unclassifiable/Attainment
Lead (2008 NAAQS)	Rest of Commonwealth	Unclassifiable/Attainment

TABLE 4.10.1-3 **Ambient Air Quality Concentrations for Areas Near the Aguirre Offshore GasPort Project**							
Pollutant	Averaging Period	Rank	2011	2010	2009	Units	Monitor(s) [a]
CO	1-Hour	2nd high	16.3	2.9	9.4	ppm	A
	8-Hour	2nd high	4.3	2.4	2.8	ppm	A
NO_2	Annual	Mean	N/A	N/A	N/A	ppb	B
	1-hour	98th percentile	N/A	N/A	N/A	ppb	B
Ozone	8-hour	4th high	0.037	0.035	0.043	ppm	C
$PM_{2.5}$	24-hour	98th percentile	13.7	24.2	16.6	µg/m^3	D
	Annual	Mean	5.4	8.0	5.3	µg/m^3	D
PM_{10}	24-hour	2nd high	55	120	58	µg/m^3	D
SO_2	1-hour	2nd high	20	13	25	ppb	E
	3-hour	2nd high	0.0143	0.0126	0.0146	ppm	E
	24-hour	2nd high	0.0127	0.0109	0.0035	ppm	E
	Annual	Mean	0.0030	0.0042	0.0041	ppm	E
Lead	Quarterly	Maximum	N/A	N/A	N/A	µg/m^3	A

[a] Monitor Key:
A = Baldorioty de Castro Av, San Juan, San Juan County (monitor no. 72-127-0003)
B = Road No. 3, Salinas, Salinas County (monitor no. 72-123-0001)
C = Rd. 183, Juncos County (monitor no. 72-077-0001)
D = Barrio Jobos, Intersection of Highways 3 & 707, Guayama County (monitor no. 72-057-0008)
E = Rd. 2 Final Las Mareas, Salinas County (monitor no. 72-123-0002)

Notes: µg/m^3 = micrograms per cubic meter; ppm = parts per million; ppb = parts per billion; N/A = data not available

4.10.1.2 Regional Climatology

The climate of Puerto Rico is classified as tropical. The Aguirre region of Puerto Rico has an average annual high of 87.9 °F (31.1 °C) and an average annual low of 70.9 °F (21.6 °C), additionally on average the Aguirre area receives 39.7 inches (100.9 cm) of rain (National Weather Service, 2013). Monthly mean wind speeds for southern Puerto Rico (years 1862 to 1973) peak during December-January at 14 mph (23 km/h) and are weakest in October at 11 mph (18 km/h) (NOAA, 2008). The island of Puerto Rico is subject to potential storms during the Atlantic hurricane season, which lasts from June through November each year. A storm with tropical-storm-strength winds passes over the island roughly once every 5 years, and a hurricane- strength storm crosses the island roughly once per decade (Andrews, 2007).

4.10.1.3 Air Quality Regulations

Federal

The CAA comprises the basic federal statute and regulation governing air pollution. The provisions of the CAA that are potentially relevant to the proposed Project include the following:

- New Source Review;
- Prevention of Significant Deterioration;
- Title V operating permit;
- Compliance Assurance Monitoring;
- New Source Performance Standards (NSPS);
- Federal Standards for Designated Facilities and Pollutants;
- National Emission Standards for Hazardous Air Pollutants (NESHAP);
- Greenhouse Gas Reporting;
- Chemical Accident Prevention and Provisions; and
- General Conformity.

<u>New Source Review</u>

Proposed new or modified air pollutant emissions sources must undergo a New Source Review (NSR) permitting process prior to construction or operation. Through the NSR permitting process, local, state, and federal regulatory agencies review and approve project construction plans, regulated pollutant increases or changes, emissions controls, and various other details. The agencies then issue construction permits that include specific requirements for emissions control equipment and operating limits. Once construction is complete, the sources are issued operating permits that specify detailed operating conditions, emissions limits, fees, reporting and recordkeeping requirements, and various other operating parameters that must be met throughout the life of the permit. The three basic categories of NSR permitting are PSD, Nonattainment NSR, and Minor Source NSR. The applicability of each NSR permitting process depends on the attainment status of a project location, and whether the project source(s) exceed specific emissions thresholds established in local, state, and federal regulations. The EPA evaluates all stationary source emissions of criteria pollutants during development of the pre-construction permit to determine whether a project is subject to major or minor NSR requirements. The proposed Project is located in an attainment area for all criteria pollutants; therefore, Nonattainment NSR does not apply to the Project.

Prevention of Significant Deterioration

PSD regulations are intended to preserve the existing air quality in attainment areas where pollutant levels are below the NAAQS. In addition to requiring an extensive review of environmental impacts, viable emissions-control technologies, and related impacts, PSD regulations impose specific limits on the amount of pollutants that major new or modified stationary sources might contribute to existing air quality levels.

The EPA uses a three-part test to determine the scope of a stationary source. Under 40 CFR 52.21(b)(5) and (6), a single stationary source includes all of the pollutant emitting activities that:

1. belong to the same industrial grouping;
2. are located on one or more contiguous or adjacent properties; and
3. are under the control of the same person (or persons under common control).

The Aguirre Plant is an existing "major source" of criteria air pollutants. Pre-construction permitting review of a physical change to (or change in the method of operation of) an existing major stationary source is required under the federal PSD program if the change meets the criteria for a "major modification." If the change results in an increase and a net increase in the annual emission rate of any of the pollutants regulated under the PSD program greater than their respective significant emissions rates, then the change is considered "major" and PSD review requirements are triggered. Aguirre LLC is proposing to install new units at the Offshore GasPort that would introduce emissions increases. A detailed discussion of PSD permitting requirements and the Aguirre Plant and Offshore GasPort is in section 4.12.2.2.

PREPA filed a PSD Non-Applicability Application with the EPA, and the EQB was provided a courtesy copy for its evaluation. In its application, PREPA asserts that the proposed Project should be considered part of the Aguirre Plant because the Offshore GasPort would be constructed to store and supply natural gas to the Aguirre Plant. Estimated emission reductions at the Aguirre Plant along with federally enforceable permit conditions for all Project equipment have been proposed at an emissions level that would render a PSD review inapplicable. The EPA issued its finding on May 6, 2014 that the Aguirre Plant and the proposed Project would not be subject to PSD requirements, provided that certain permit conditions are included in the EQB construction permits for both the Aguirre Power Complex and the Project.

Title V Operating Permit

Operating permits are legally enforceable documents that permitting authorities issue to air pollution sources after the source has begun to operate. The operating permit is designed to improve compliance by clarifying what facilities (sources) must do to control air pollution. Under the EPA's delegation, the EQB is the permitting authority for the Title V operating permit program in Puerto Rico. The proposed Project is subject to Title V operating permit requirements (including the Title V portion of the EPA's Greenhouse Gas Tailoring Rule) and because the Offshore GasPort and the Aguirre Plant would be permitted as one stationary source, the modification to the Aguirre Plant's current Title V operating permit is considered a "significant modification." The Aguirre Plant is currently operating under the CAA Title V Operating Permit PFE-TV-4911-63-0796-0005.

On November 5, 2013, the EPA issued a letter noting that the Offshore GasPort would be capable of unloading 183 billion standard cubic feet of natural gas per year; however, potential emissions were calculated based on an annual unloading amount of 159 billion standard cubic feet per year. On May 6, 2014, the EPA asserted that a permit condition be included in the EQB construction permit for the Project that would limit the unloading amount of LNG to 159 billion standard cubic feet per year, to which PREPA agreed. PREPA will submit a modification to its existing Title V permit to include the conditions in the RCAP Part 203 Permit to Construct when it is issued.

Compliance Assurance Monitoring

As mentioned above, the FSRU would be subject to a Title V Operating Permit, each FSRU boiler would have uncontrolled nitrogen oxides (NO_x) emissions in excess of the major source threshold (100 tons per year [tpy]) (91 metric tons per year [mtpy]), and each FSRU boiler would be using add-on control equipment to comply with a NO_x emissions limit. Therefore, the boilers would be subject to the Compliance Assurance Monitoring requirements of 40 CFR 64 unless the Title V permit specifies a continuous compliance method.

New Source Performance Standards

The EPA has established NSPS at 40 CFR 60 that regulate air pollutant emissions from certain categories of stationary sources. In addition to the General rules in Subpart A, equipment within the Project would be subject to certain other subparts as identified below. Based on past precedent, emission sources onboard the LNG carriers delivering cargo are exempt from applicability under NSPS because they are not stationary sources. The NSPS requirements are therefore only applicable to emission sources on the FSRU and the terminal platform.

Subparts Ce, Ec, CCCC, DDDD EEEE, and FFFF – Standards of Performance for Incinerators

Subparts Ce, Ec, CCCC, DDDD, EEEE, and FFFF can apply to small stationary source incinerators, with the applicability of each depending upon the age of the incinerator and the type of material being incinerated. The FSRU and visiting LNG carriers can be equipped with shipboard incinerators, typically relatively small (e.g., 10 tons per day capacity). LNG carrier incinerators are not “stationary sources” and are therefore exempt from these requirements. The incinerator on the FSRU would not be utilized while the FSRU is at the offshore berthing platform, and therefore these subparts do not apply to the Project. Permit conditions will ensure compliance with this subpart.

Subpart Db – Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units

Subpart Db applies to steam generating units constructed, reconstructed, or modified after June 19, 1984 with a heat input capacity of greater than 100 MMBtu/hour. A “steam generating unit” is defined in this Subpart as a device that combusts any fuel and produces steam or heats water or heats any transfer medium. The boilers on visiting LNG carriers are not “stationary” and are not subject to this rule. The main boilers and auxiliary boiler on the FSRU would have a heat input capacity of at least 100 MMBtu/hour; however, when each boiler was constructed, it met the definition of a “temporary boiler” (“...designed to, and...capable of being carried or moved from one location to another...”), which is not subject to Subpart Db (per 40 CFR 60.40b(m)). Since NSPS applies to stationary sources at the time of construction, reconstruction, or modification, and anchoring or docking the marine vessel that the boilers are installed on does not constitute an act of construction, reconstruction, or modification, the NSPS in Subpart Db do not apply to the boilers on the FSRU.

Subpart Dc – Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units

Subpart Dc (40 CFR 60.41c) applies to stationary source boilers constructed, reconstructed, or modified after June 9, 1989 with a heat input capacity of between 10 and 100 MMBtu/hour. The inert gas generator onboard the LNG carriers has a heat input capacity within this range but does not heat water or a heat transfer medium and therefore does not meet the definition of "steam generating unit."

Subpart Kb, Standards of Performance for Volatile Organic Liquid Storage Vessels

Subpart Kb applies to storage vessels constructed, reconstructed, or modified after July 23, 1984 with a capacity greater than or equal to 19,813 gallons (75 m^3) that are used to store a volatile organic liquid, which is any organic liquid which can emit VOCs (as defined in 40 CFR 51.100) into the atmosphere. The FSRU and LNG carriers would include tanks of various sizes for storage of LNG, fuel oil, lubricants, and waste oil. However, storage vessels permanently attached to mobile vehicles, including ships, are exempt from Subpart Kb under 40 CFR 60.110b(d)(3). The terminal platform would include several small storage tanks for fuel oil, lubricants, and waste oil, each with a capacity far less than 19,813 gallons (75 m^3). As the Project would not include any volatile organic liquid storage tanks having a capacity greater than 19,813 gallons (75 m^3) that meet the applicability outlined in 40 CFR 60.110b, Subpart Kb is not applicable to the Project.

Subpart IIII – Stationary Compression Ignition Internal Combustion Engines

Subpart IIII applies to owners and operators of stationary compression ignition internal combustion engines that commence construction after July 11, 2005 where the stationary compression ignition internal combustion engines are manufactured after April 1, 2006 and are not fire pump engines, or manufactured as a certified NFPA fire pump engine after July 1, 2006. The two diesel platform gensets and two diesel fire pumps would be subject to Subpart IIII and compliance would be assured by purchasing engines that are certified by the manufacturers to meet the corresponding emissions standards, per 40 CFR 60.4211(c). The duel-fuel diesel electric (DFDE) and other small engines (e.g., emergency generator, lifeboat engines, etc.) onboard the FSRU and visiting LNG carriers are not stationary internal combustion engines. Subpart IIII defines a "stationary combustion engine" as excluding nonroad engines. A nonroad engine, as defined in 40 CFR 1068.30 section (1)(i), specifically includes engines that are used in or on a piece of equipment that is self-propelled. There is an exclusion in section (2)(iii) of the definition of "nonroad engine" that applies to engines remaining at a single location for more than 12 consecutive months, but that exclusion only applies to engines meeting section (1)(iii) of the definition – i.e., those that are "portable or transportable, meaning designed to be and capable of being carried or moved from one location to another" – and not the engines on self-propelled equipment described in section (1)(i) of the definition.

Subpart IIII only applies to owners and operators of stationary engines that "commence construction" (or were modified or reconstructed) after July 11, 2005, and defines "commence construction" as the date the engine was ordered [40 CFR 60.4200(a)]. In this case, construction was never commenced on a stationary engine on the date that the engine was ordered (through the current time); the engine was and still is a nonroad engine. Anchoring or docking the marine vessel that the engines are installed on does not constitute an act of ordering the engine (commencing construction), modification, or reconstruction, and therefore, Subpart IIII would not apply to the engines on the FSRU. Because this situation is relatively unique, it was discussed with EPA Region 2 by conference call on November 19, 2012; EPA Region 2 agreed with this interpretation (Kennedy, 2012).

Subpart JJJJ – Stationary Spark Ignition Internal Combustion Engines

Subpart JJJJ applies to owners and operators of stationary spark ignition internal combustion engines that are ordered after June 12, 2006 where the stationary spark ignition internal combustion engines are manufactured after a specified date (for engines smaller than 500 horsepower (hp) such as those proposed here, the date is July 1, 2008). The two spark ignition internal combustion engines platform gensets would be subject to Subpart JJJJ and would meet the corresponding emissions limits (1.0 grams per horsepower-hour [g/hp-hr] NO_x, 2.0 g/hp-hr CO, 0.7 g/hp-hr volatile organic compounds [VOC]). The DFDE and other spark ignition engines on the FSRU are not stationary engines since they are classified as nonroad engines, as described in the prior subsection on Subpart IIII. Thus, the FSRU engines are not subject to Subpart JJJJ, as verified by EPA in Excelerate Energy's April 11, 2013 letter (Riva, 2013).

Subpart OOOO – Crude Oil and Natural Gas Production, Transmission and Distribution

Subpart OOOO rule regulates emissions of VOCs and SO_2 from facilities constructed or modified after August 23, 2011. The rule addresses emissions limits and work practice standards for completions of hydraulically fractured gas wells, pneumatic devices, compressors, and tanks.

The Offshore GasPort does not include any oil wells or gas wells and does not sweeten or otherwise process (e.g., dehydrate, fractionate, etc.) the gas, and therefore does not have any "process units" and is not an "affected facility" under §60.5365(a)-(d) or (f)-(h) of Subpart OOOO.

Although under Subpart OOOO the storage vessels on the FSRU meet the regulatory applicability definition of "storage vessel," the applicable requirements for storage vessels only apply to storage vessels at well sites with VOC emissions greater than 6 tons (5.4 metric tons) per year [§60.5395(a)]. Since there are no well sites at this facility (and LNG has negligible VOC emissions), these requirements do not apply.

Federal Standards for Designated Facilities and Pollutants

Subparts HHH, III, and JJJ of 40 CFR 62 include requirements that can potentially apply to incinerators, with the applicability of each depending upon the age of the incinerator and what exactly is being incinerated. The FSRU and visiting LNG carriers can be equipped with shipboard incinerators, which typically are relatively small (e.g., 10 tons per day [9 metric tons per day] capacity). LNG carrier incinerators are not "stationary sources" and are therefore exempt from these requirements. The incinerator on the FSRU would not be utilized while the FSRU is at the offshore berthing platform. Therefore, Subparts HHH, III, and JJJ do not apply to the Offshore GasPort.

National Emission Standards for Hazardous Air Pollutants

The NESHAP, codified in 40 CFR Parts 61 and 63, regulate hazardous air pollutant (HAP) emissions. Part 61 was promulgated prior to the 1990 CAA Amendments and regulates only eight types of hazardous substances (asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride). The proposed Project is not in one of the source categories regulated by Part 61; therefore, the requirements of Part 61 are not applicable.

The 1990 CAA Amendments established a list of 189 HAPs, resulting in the promulgation of Part 63. Part 63, also known as the Maximum Achievable Control Technology standards, regulates HAP emissions from both major sources of HAP emissions and non-major (area) sources of HAP emissions within specific source categories. Part 63 defines a major source of HAP as any "stationary source or group of stationary sources located within a contiguous area and under common control" that has the potential to emit 10 tpy (9 mtpy) of any single HAP or 25 tpy (23 mtpy) of HAPs in aggregate. For the same reasons identified in the discussion of PSD applicability above, the Offshore GasPort is being considered as "within a contiguous area and under common control" with the Aguirre Plant. The latter alone is a major source of HAPs and this fact does not change as a result of implementing Project; therefore, the combination of the Offshore GasPort and Aguirre Plant is also a major source of HAP.

Subpart Y – National Emission Standards for Marine Tank Vessel Loading Operations

Subpart Y (40 CFR 63.561) establishes requirements for existing major sources of HAPs and for new marine vessel loading operations at major HAP sources and area (non-major) sources of HAP. Subpart Y defines marine vessel loading operations as "any operation under which a commodity is bulk loaded onto a marine tank vessel from a terminal, which may include the loading of multiple marine tank vessels during one loading operation." However, this subpart does not apply to marine tank vessel loading operations at loading berths that only transfer liquids containing organic HAP as impurities. As defined in this subpart, "impurity" means HAP substances that are present in a commodity or that are produced in a process coincidentally with the primary product or commodity and that are 0.5 percent total HAP by weight or less. Also, the impurity does not serve a useful purpose in the production or use of the primary product or commodity and is not isolate. The HAP compounds present in LNG are only impurities and, therefore, Subpart Y does not apply to the Project.

Subpart EEE – Hazardous Waste Incineration

Subpart EEE can apply to the incineration of "hazardous waste." The definition of "hazardous waste" is complex but specifically excludes household waste, including any material (i.e. garbage, trash, and sanitary wastes in septic tanks) derived from households (including crew quarters) [40 CFR 261.4(b)(1)]. The FSRU and visiting LNG carriers can be equipped with shipboard incinerators, typically relatively small (e.g., 10 tons per day [9 metric tons per day] capacity). The FSRU's incinerator would not be operated at the offshore berthing platform, and visiting LNG carriers would be required to not incinerate anything at the platform other than "household waste" as described above. Therefore, Subpart EEE does not apply to the Project.

Subpart ZZZZ – NESHAP for Stationary Reciprocating Internal Combustion Engines

Subpart ZZZZ applies to stationary reciprocating internal combustion engines. The platform engines would be "new" (commencing construction on or after June 12, 2006) and because the gensets are all 500 hp or smaller, there are no additional requirements under Subpart ZZZZ (i.e., compliance with the Subpart IIII NSPS is all that Subpart ZZZZ requires for these engines). The platform fire pump engines may be larger than 500 hp in which case they would be subject to the applicable requirements under Subpart ZZZZ and meet the requirements for "emergency stationary reciprocating internal combustion engines" (no more than 100 hours/year of non-emergency operation, no more than 50 of which can be for operations other than maintenance checks and readiness testing). For the engines on the FSRU, as with NSPS Subpart IIII, this subpart defines a "stationary reciprocating internal combustion engine" as excluding nonroad engines (as defined in 40 CFR 1068.30). For the same reasons identified in NSPS Subpart IIII, the FSRU engines are considered nonroad engines and should not be subject to Subpart ZZZZ. Because this situation is relatively unique, confirmation of this interpretation was requested of EPA Region 2 and EPA confirmed this interpretation by letter dated April 11, 2013 (Riva, 2013).

Subpart DDDDD – NESHAP for Industrial, Commercial, and Institutional Boilers and Process Heaters

Subpart DDDDD can apply to industrial, commercial, and institutional boilers that are located at a major source of HAPs. The LNG carrier boilers meet the definition of "temporary boilers" in 40 CFR 63.7575 and are therefore exempt per section 63.7491(j). As identified in the Subpart DDDDD revisions[13], the definition of "temporary boiler" excludes boilers that (1) are attached to a foundation;

[13] See volume 78 of the Federal Register, page 7192 (January 31, 2013).

(2) that remain at a location within the facility and performs the same or similar function for more than 12 consecutive months (any temporary boiler that replaces a temporary boiler at a location and performs the same or similar function would be included in calculating the consecutive time period), unless the regulatory agency approves an extension (which may be granted by the regulating agency upon petition by the owner or operator of a unit specifying the basis for such a request); (3) that are located at a seasonal facility and operate during the full annual operating period of the seasonal facility, remain at the facility for at least 2 years, and operate at that facility for at least 3 months each year; or (4) are moved from one location to another within the facility but continue to perform the same or similar function and serve the same electricity, steam, and/or hot water system in an attempt to circumvent the residence time requirements of the definition. Therefore, Aguirre LLC is assuming that the FSRU boilers do not meet the definition of "temporary boilers" and would be subject to Subpart DDDDD. EPA Region 2 concurred with this interpretation as well (Kennedy, 2012).

As the FSRU boilers would have been constructed prior to June 4, 2010, they would be subject to the Table 2 standards applicable to "existing" boilers (per 40 CFR 63.7490). Because oil would be required to light boiler burners for more than 48 hours per year, the boilers are in the "Unit designed to burn liquid" subcategory. Because the Project is in Puerto Rico, each boiler is the subcategory of "Unit designed to burn liquid fuel that is a non-continental unit." During normal operation (when boil-off gas is being fired, with or without oil used for burner lighting), the boilers would meet all applicable limits. If gas supply is curtailed and the FSRU needs to operate on oil only, AP-42 emission factors indicate that emissions of hydrogen chloride could potentially exceed the applicable limits. If a situation of gas curtailment were projected to arise, Aguirre LLC would commit to analyzing the oil for chlorine content before using it in the boilers.

The inert gas generator on FSRU does not meet the definition of "boiler" or "process heater" in section 63.7575 (i.e., its purpose is not to recovery thermal energy or transfer heat) and therefore is not subject to Subpart DDDDD.

Subpart JJJJJJ – NESHAP for Industrial, Commercial, and Institutional Boilers Area Sources

Subpart JJJJJJ applies to new or existing boilers located at an area source of HAPs. The definition of an area source for this regulation means any source of HAPs that is not a major source. Because the Aguirre Plant is a major source of HAPs, Subpart JJJJJJ is not applicable.

Greenhouse Gas Reporting

On November 8, 2010, the EPA signed a rule that finalizes reporting requirements for the petroleum and natural gas industry under 40 CFR 98. Subpart W of 40 CFR 98 requires petroleum and natural gas facilities that have actual GHG emissions of 25,000 metric tons or more of carbon dioxide equivalent (CO_2e) per year to report annual emissions of specified GHGs from various processes within the facility and conduct associated monitoring. LNG storage and LNG import and export equipment are considered part of the source category regulated by Subpart W. Therefore, if actual emissions from the Aguirre Plant or the Offshore GasPort exceed the 27,500 ton (25,000-metric ton) threshold, it would be required to comply with all applicable requirements of the rule.

Chemical Accident Prevention Provisions

LNG facilities are subject to DOT safety regulations (e.g., 49 CFR 193 and 33 CFR 127). Section 112(r) of the CAA and associated EPA regulations (40 CFR 68) apply to owners or operators of stationary sources producing, processing, handling, or storing toxic or flammable substances. However, the EPA's General Counsel has clarified that Section 112(r) and the associated regulations do not apply to

LNG facilities to the extent that these facilities transport such substances, or store them incident to transportation (Klee, A. 2003). Aside from LNG, which would be stored incident to transportation, the Project would not be storing hazardous or flammable substances in excess of any thresholds identified in 40 CFR 68, and therefore those regulations do not apply. Aqueous urea would be used for the selective catalytic reduction (SCR) systems, rather than ammonia, and would be stored in tanks onboard the FSRU. 40 CFR 68 does not apply to the storage of aqueous urea, because it is not a listed substance under Section 112(r). However, for these tanks, the 112(r)(1) general duty clause does apply:

> The owners and operators of stationary sources producing, processing, handling or storing [hazardous] substances have a general duty in the same manner and to the same extent as section 654, title 29 of the United States Code, to identify hazards which may result from [accidental] releases using appropriate hazard assessment techniques, to design and maintain a safe facility taking such steps as are necessary to prevent releases, and to minimize the consequences of accidental releases which do occur.

Aguirre LLC would take steps necessary to meet the general duty provisions above at the Offshore GasPort.

<u>General Conformity</u>

General conformity regulations in 40 CFR 93, Subpart B can only apply to areas designated as "nonattainment" or "maintenance" areas with respect to the NAAQS. Table 4.10.1-2 lists the attainment designations for the Project area. None of the areas in the vicinity of the Project are designated as "nonattainment" with respect to any pollutant. No areas are "maintenance" areas for any pollutant either. Therefore, the general conformity regulations do not apply.

International MARPOL Annex VI

The IMO created MARPOL in 1973, and has subsequently promulgated Annex VI, Regulations for the Prevention of Air Pollution from Ships, which was adopted in 1997 and which became effective in 2005. MARPOL Annex VI applies to all ships and regulates emissions of NO_x and sulfur oxides. Regulation 13 of Annex VI establishes NO_x limits for marine diesel engines. The DFDE on the FSRU is subject to the Tier I NO_x limit for marine diesel engines constructed between the dates of January 1, 2000 and January 1, 2011. The emission limit is based on the rated engine speed (n), and is calculated using the formula $45*n^{-0.2}$ grams per kilowatt hour (g/kWh), when n is 130 or more but less than 2,000 revolutions per minute. The DFDE has a rated speed of 720 revolutions per minute, resulting in a Tier I NO_x limit of 12.1 g/kWh. The FSRU DFDE can currently comply with this limit.

Regulation 14 of Annex VI establishes limits on the sulfur content of any fuel used onboard ships. Fuel sulfur content is limited to 3.5 percent by weight on or after January 1, 2012, and 0.5 percent by weight on or after January 1, 2020. Regulation 14 also establishes certain Emission Control Areas (ECA) that have lower sulfur content limits. Currently, established ECAs have a sulfur in fuel limit of 1 percent by weight except for vessels with approved exhaust gas cleaning systems or any other technological method to meet a sulfur oxides limit equivalent to the sulfur in fuel limit. Vessels operating in ECAs must use fuel with a sulfur content less than or equal to 0.1 percent beginning January 1, 2015.

A Caribbean ECA was designated in July of 2011, which includes the coastal waters within 50 nautical miles (93 km) of the coast of Puerto Rico. Sulfur in fuel limits in this new ECA became effective on January 1, 2014. Therefore, in 2014, vessels in the Project area would need to limit sulfur in fuel to 1 percent (unless they have an approved exhaust cleaning system) and on January 1, 2015, would need to limit sulfur in fuel to 0.1 percent (unless they have an approved exhaust cleaning system). These provisions have the potential to affect the LNG carriers delivering cargo to the Offshore GasPort and potentially the FSRU. Importantly, this amendment for ECAs has an exemption for ships built on or before August 1, 2011 that are powered by propulsion boilers that were not originally designed for continued operation on marine distillate fuel or natural gas. Vessels in the EBRV fleet fall into this category. For these vessels, the 0.1 percent sulfur requirements may not be applied prior to January 1, 2020.

Regulation 16 of Annex VI establishes international requirements for shipboard incineration, including prohibitions on incinerating certain types of materials and continuous outlet temperature monitoring while the incinerator is operating. Both the FSRU and LNG carriers would adhere to the applicable requirements of this regulation.

Puerto Rico/Local

The EQB is the permitting authority for air emissions from the Project not subject to PSD. The EQB has promulgated air quality requirements in their Regulations for the Control of Atmospheric Pollution. Below is a description of the potentially applicable local air quality requirements.

Rule 201 Location Approval

All new major stationary sources, or major modifications of existing sources, must obtain a location approval from the EQB prior to construction. In order to obtain a location approval, it must be demonstrated that the location is "propitious" with respect to existing air quality, locate climate and meteorology, existing land use, and effects on nearby ecological sensitive areas. Proposed emissions must not violate any applicable NAAQS for pollutants in attainment of the standards, or exceed significant impact levels for any non-attainment pollutants. Proposed emissions must be limited by means of Best Available Control Technology for attainment pollutants, and by means of Lowest Achievable Emission Rate technology for any non-attainment pollutants. The applicant must comply with Rule 201 through submitting an application for Location Approval.

Rule 202 Air Quality Impact Analysis

When required by the EQB, an air quality impact analysis shall be performed, demonstrating that the proposed emissions, in conjunction with all other applicable emission increases or reductions, would not significantly cause or contribute to air pollution in violation of any NAAQS. See Section 4.10.1.5 of this analysis for a discussion of predicted air quality impacts.

Rule 203 Permit to Construct

All new sources or modifications of existing sources shall apply for and receive a Rule 203 Permit to construct prior to beginning construction. As part of the federal permitting process, the PREPA would provide the information required under Rule 203 for construction permit applications, including a certification by a professional engineer licensed in Puerto Rico that the technical information is true and complete. The Project would comply with Rule 203 and obtain a Permit to Construct.

Rule 204 Permit to Operate

Rule 204 requires sources to obtain an operating permit prior to commencing operation. However, sources that are required to obtain a permit under the federal Title V Operating Permit program are exempt from the requirements of this rule. PREPA will submit to the EPA a modification to its existing Title V permit to include the Project.

Rule 206 Exemptions

Rule 206 lists a number of activities that are exempt from the requirement to obtain a construction permit under Rule 203 or an operating permit under Rule 204. A variety of exempt activities such as air conditioning, ventilation systems, kitchen equipment, and cleaning equipment would be present on the FSRU, terminal platform, and LNG carriers.

Rule 403 Visible Emissions

Stationary sources are limited to visible emissions of no more than 20 percent opacity, except that visible emissions up to 60 percent opacity are permitted for up to 4 minutes in any consecutive 30-minute interval. Compliance shall be determined using the test methods in Rule 106, which incorporates the methods of 40 CFR 60 by reference, and requires the submittal of a test protocol to EQB for approval. Visible emissions from maritime vessels are limited to 20 percent opacity, while anchored or moored at any port, pier, dock, harbor, or bay in the Commonwealth of Puerto Rico, except that visible emissions up to 60 percent opacity are permitted for up to 4 minutes in any consecutive 30-minute interval. Compliance shall be determined using EPA Reference Methods 9 or 9A.

Rule 404 Fugitive Emissions

No person shall cause or permit any materials to be handled, transported, or stored in a building, its appurtenances, or a road to be used, constructed, altered, repaired, or demolished, without taking reasonable precautions to prevent particulate matter from becoming airborne. The Project is expected to comply with Rule 404 and would take the appropriate measures to control and prevent particulate matter gains access to the atmosphere.

Rule 405 Incineration

Rule 405 requires non-hazardous solid waste incinerators to complete performance tests, comply with an emissions limit, and submit training certificates to EQB. The FSRU would be equipped with a small incinerator for disposal of various wastes, but this would not be operated at the offshore berthing platform. While most LNG carriers would also be equipped with a shipboard incinerator, it is understood that shipboard incinerators are not subject to Rule 405. This would be confirmed with EQB; if they are subject to Rule 405, Aguirre LLC may require that LNG carriers either not operate their shipboard incinerators while at the Offshore GasPort, or else comply with all applicable requirements of Rule 405.

Rule 406 Fuel Burning Equipment

Rule 406 limits emissions of particulate matter from any type of fuel burning equipment to 0.30 pound per MMBtu. All Project emissions sources would comply with this limit.

Rule 410 Maximum Sulfur Content in Fuels

For any fuel burning equipment constructed after the effective date of this rule, a fuel sulfur content of 2.5 percent by weight shall not be exceeded, provided that this would not result in the violation of any NAAQS. For any fuel burning equipment with a heat input capacity greater than 8 MMBtu/hour, the owner or operator must request a sulfur percent assignment from the EQB. All Project emissions sources would comply with this limit and if exceeds the limit would request a sulfur percent assignment from the EQB.

Rule 412 Sulfur Dioxide Emissions

No person shall cause or allow the emission of sulfur compounds into the air, expressed as SO_2, with a concentration greater than 1,000 ppm (1,000 mg/L) by volume, and standard conditions and corrected to 21 percent O_2. All Project emissions sources would comply with this limit.

Rule 417 Storage of Volatile Organic Compounds

VOC storage tanks larger than 40,000 gallons (151,412 liters) must either be pressurized, be equipped with a floating roof, or be equipped with a vapor recovery and disposal system. Storage tanks are exempt from these requirements if used to store a liquid with a true vapor pressure of less than 0.75 psi absolute. The FSRU, terminal platform, and LNG carriers would have various storage tanks for diesel oil, heavy fuel oil, and lubricating oils. All of these substances have vapor pressures less than 0.75 psi absolute and are, therefore, exempt from this rule.

Rule 420 Objectionable Odor

As enforceable by the State under Rule 420, no person shall cause or permit emission to the atmosphere of matter which produces an "objectionable" odor that can be perceived on an area other than that designated for industrial purposes. The Offshore GasPort is not expected to emit to the atmosphere matter which produces an "objectionable" odor that can be perceived on an area other than that designated for industrial purposes (note: the minimum distance to a human receptor is 1.7 miles [2.7 km]). If odors are detectable beyond the property perimeter, and complaints are received, Aguirre LLC would investigate and take measures to minimize and/or eliminate odors as necessary.

Title V Operating Permits

Rules 601 through 605 describe the requirements for applying for and issuing Title V operating permits for new major stationary sources. The Aguirre Plant is currently operating under the CAA Title V Operating Permit PFE-TV-4911-63-0796-0005. PREPA will submit a modification to this Title V permit to the EPA to include the Project.

4.10.1.4 Construction Emissions Impact and Mitigation

Construction of the Project is anticipated to take approximately 12 months. Only a small portion of the construction emissions occur on land because the facility would consist primarily of subsea and offshore structures. The applicant must submit a schedule for the proposed construction of the Project as part of the application for Location Approval (EQB Rule 201). Estimated construction emissions by Project component are described below.

Subsea Interconnecting Pipeline and Offshore Terminal

Pipeline construction would involve various vessels with specialized construction capabilities, as well as other vessels to support construction activities. These vessels would include a crew/supply boat, spud barge, lay barge, assist tugs, survey vessel, pipe transport barge, and pipe transport tug. Construction of the subsea pipeline would take place over a period of approximately 4 months, and is estimated to include 113 days of operation for a number of marine vessels supporting construction. Completion of the pipeline includes several other tasks, such as dive support, conducting hydrostatic testing of the pipeline, and performing an as-built survey.

For the offshore berthing platform, Aguirre LLC would pursue the use of prefabricated modular designs, made up of elements fabricated under plant conditions rather than on site. Use of prefabricated elements reduces the need for onsite complex formwork operations over water. Advantages include a reduced construction schedule and smaller crews and associated marine support. Minimized labor time on-site in the marine environment reduces the temporary air pollutant emissions associated with construction activities. Construction of the offshore platform would take place over a period of approximately 11 months, and is estimated to include 200 days of operation for a derrick barge and an assist tug. Table 4.10.1-4 lists calculated pollutant emission totals for construction of the subsea pipeline and offshore platform. It is assumed that all marine engines would be in compliance with applicable marine emission standards. However, for the purpose of estimating emissions, factors from EPA's AP-42 compilation were used for criteria pollutants, and default emission factors from 40 CFR 98 were used for GHGs.

TABLE 4.10.1-4

Subsea Pipeline and Offshore Platform Construction Emissions (tons [metric tons]) for the Aguirre Offshore GasPort Project

Source	NO_x	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	HAP	CO_2e
Crew/Supply Boat	4.4 (4.0)	1.2 (1.1)	0.11 (0.09)	0.14 (0.13)	0.14 (0.13)	0.14 (0.13)	0.007 (0.006)	224 (203)
Spud Barge	2.7 (2.4)	0.6 (0.5)	0.21 (0.19)	0.19 (0.17)	0.19 (0.17)	0.06 (0.05)	0.004 (0.003)	99 (90)
Lay Barge	42.7 (38.7)	10.6 (9.6)	1.84 (1.67)	1.88 (1.71)	1.88 (1.71)	1.26 (1.14)	0.067 (0.061)	1,987 (1,803)
Assist Tug no. 1	8.4 (7.6)	2.2 (2.0)	0.21 (1.67)	0.26 (0.24)	0.26 (0.24)	0.27 (0.25)	0.013 (0.012)	428 (388)
Pipe Transport Tug	8.4 (7.6)	2.2 (2.0)	0.21 (1.67)	0.26 (0.24)	0.26 (0.24)	0.27 (0.25)	0.013 (0.012)	428 (388)
Hydrostatic Testing	0.6 (0.5)	0.1 (0.1)	0.05 (0.05)	0.04 (0.04)	0.04 (0.04)	0.01 (0.01)	0.001 (0.001)	21 (19)
Derrick Barge	50.1 (45.4)	10.8 (9.8)	4.0 (3.6)	3.5 (3.2)	3.5 (3.2)	1.2 (1.1)	0.08 (0.07)	1,857 (1,685)
Assist Tub no. 2	152.5 (138.3)	40.5 (36.7)	3.9 (3.5)	4.8 (4.4)	4.8 (4.4)	4.9 (4.4)	0.23 (0.21)	7,796 (7,072)
Total	**269.6 (244.5)**	**68.2 (61.8)**	**10.5 (9.5)**	**11.1 (10.1)**	**11.1 (10.1)**	**8.1 (7.3)**	**0.4 (0.4)**	**12,841 (11,649)**

Note: The numbers in this table have been rounded for presentation purposes. As a result, the conversions may not be exact in all cases.

FSRU

Aguirre LLC would use a vessel from Excelerate Energy's existing fleet as the FSRU for the Project; therefore, no new construction emissions would result from the FSRU component of the Project.

Onshore Connection

The construction office and onshore contractor staging areas would be located on industrial land within the Aguirre Plant property. Aguirre LLC anticipates utilizing an existing pier, also within the Aguirre Plant property, with direct access to the Jobos Bay barge channel.

During offshore construction, the onshore staging area would be used for 15 weeks. Aguirre LLC estimates two delivery trips per week for a heavy diesel truck, and five trips per week for a light duty gasoline pickup truck. Table 4.10.1-5 shows the estimated vehicle miles traveled based on an estimated 25 miles (40 km) per trip.

TABLE 4.10.1-5 **On-Road Vehicle Use for the Onshore Staging Area for the Aguirre Offshore GasPort Project**					
			Estimated Activity		
Vehicle	Number of Vehicles	Number of Weeks	Trips per Week	Miles per Trip (km)	Vehicle Miles Traveled (km)
Light-duty Gasoline Truck	1	15	5	25 (40)	1,875 (3,018)
Heavy-duty Diesel Truck	1	15	2	25 (40)	750 (1,207)

Note: The numbers in this table have been rounded for presentation purposes. As a result, the conversions may not be exact in all cases.

Table 4.10.1-6 shows estimated emissions for on-road vehicles and fugitive dust associated with activities in the onshore staging area. Emissions for on-road vehicles have been calculated using emission factors from MOBILE 6.2 and the Climate Registry. Fugitive dust emissions have been estimated assuming 1 acre (1 cuerda) of disturbed land, with a duration of 4 months each for construction and staging activities. Water spray and other dust suppression measures would be used to reduce dust emissions.

TABLE 4.10.1-6 **On-Road Vehicle and Fugitive Dust Emissions (tons [metric tons]) for the Aguirre Offshore GasPort Project**							
Source	CO	NO_x	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2e
On-Road Vehicle Engines	0.02 (0.02)	3E-03 (3E-03)	3E-05 (3E-05)	1E-03 (1E-03)	6E-05 (6E-05)	6E-05 (6E-05)	2.29 (2.08)
Fugitive Dust					0.25 (0.23)	0.03 (0.03)	
Totals	0.02 (0.02)	3E-03 (3E-03)	3E-05 (3E-05)	1E-03 (1E-03)	0.25 (0.23)	0.03 (0.03)	2.29 (2.08)

Note: The numbers in this table have been rounded for presentation purposes. As a result, the conversions may not be exact in all cases.

Based on the analysis above and Aguirre LLC's proposed mitigation measures, we conclude that construction of the Project would not result in a significant impact on local or regional air quality.

4.10.1.5 Operational Emissions Impact and Mitigation

The operational air emission sources associated with the Project would include equipment on the FSRU, the terminal platform, and the LNG carriers. The assumptions used to determine annual total emissions are presented below.

FSRU

The FSRU is equipped with two main boilers, one auxiliary boiler, and one DFDE. The two main boilers, each rated at 224 MMBtu/hour, are capable of firing any combination of boil-off gas, heavy fuel oil, or both fuels simultaneously. The boilers are also capable of burning a small quantity of distillate oil, for the sole purpose of starting a cold boiler. HFO would be burned during boiler startups. In the event of a cold startup, the boilers must be lit with a lighter grade of marine distillate oil until sufficient steam is available to heat heavy fuel oil to the required temperature for pumping and atomization in the burners. However, the startup emission calculations assumed heavy fuel oil as the only fuel throughout the startup. The main boilers would burn boil-off gas as the only fuel during routine operation, except for periodic burner lightings when both boil-off gas and heavy fuel oil would be burned for a brief time, estimated as equivalent to one 30-minute period per boiler per day. The Project would also require the capability for a limited amount of heavy fuel oil-firing, equivalent to 744 hours per year per boiler (which includes 48 hours of cold startup per year per boiler at approximately 33 percent load, and 696 hours per year per boiler at approximately 10 percent load, to maintain hoteling power during maintenance and periods when no LNG cargo is available). During operation on boil-off gas, the main boilers would use SCR to control NO_x emissions.

For the main boilers, the worst-case combination of operating scenarios was selected for each pollutant. For NO_x, PM_{10}, $PM_{2.5}$, SO_2, and N_2O, the worst-case annual emissions result from 7,833 hours of operation on boil-off gas with SCR at 100 percent load; 696 hours of operation on heavy fuel oil at approximately 10 percent load; 48 hours of cold startups firing heavy fuel oil only, at an average load of 33 percent; and 183 hours of burner lightings. For CO, VOC, HAP, ammonia, CO_2, CH_4, and CO_2e, worst-case annual emissions are based on 8,577 hours of operation on boil-off gas only, with SCR, at 100 percent load; and 183 hours of burner lightings. The emissions conservatively include all emissions from the boilers, regardless of the extent to which boiler power was used to unload LNG vs. hoteling (i.e., the latter have not been excluded). For the auxiliary boiler, 8,760 hours of operation on boil-off gas with SCR at 100 percent load are assumed.

The auxiliary boiler, rated at up to 157 MMBtu/hour, would burn regasified LNG as its only fuel. SCR would be used to control NO_x emissions at all times, except during startup and shutdown periods. During periods when insufficient LNG cargo is available to provide fuel, the auxiliary boiler would not operate.

The DFDE, rated at 4,020 kilowatts (kW), is capable of burning either marine distillate oil or regasified LNG with a small amount of marine distillate oil (approximately 1 percent of total heat input) used as pilot fuel. The DFDE would have a limited number of operating hours: approximately 365 hours per year on regasified LNG to provide electrical power for starting the high pressure send out pump, and up to 864 hours per year on either marine distillate oil or regasified LNG to provide electrical power while one or more steam turbine generators is undergoing maintenance.

The miscellaneous small engines on the FSRU include a rescue boat engine rated at 144 hp, a lifeboat with two engines rated at 29 hp each, and an emergency generator rated at 620 kW. All of these engines burn distillate oil with an assumed sulfur content of 15 ppm by weight, and during routine GasPort operations would only run for 30 minutes of testing per week. The FSRU is also equipped with a small shipboard incinerator, but this would not be used at the offshore berthing platform. To the extent that sources are associated with hoteling and other vessel functions not associated with LNG transfer, storage, or gasification—as is the case for the incinerator, emergency generator engines, and lifeboat engines—they are not considered part of the permitted stationary source under the PSD program (per EPA Region 2). However, potential emissions from the emergency generator and lifeboat engines are estimated in this analysis for disclosure purposes.

Platform Equipment

The terminal platform would be equipped with four electric generators with reciprocating engines, each rated at approximately 238 to 350 kW. Two engines would burn natural gas exclusively, and two would burn diesel oil exclusively. The engines would turn generators to provide electric power for various activities on the platform, including lighting, switches and controls, fire pumps, and other uses. The two natural gas-fired engines would be running at 100 percent load for 8,760 hours. In addition, one of the two diesel oil-fired generators would operate at 100 percent load for the duration of LNG carrier mooring, cargo transfer, and LNG carrier unmooring operations, or 2,300 hours per year. The maximum load required by platform equipment is approximately 662 kW, so only a maximum of three of the engines are expected to operate at any given time and total facility emissions are based on this. The platform would include several storage tanks for fuel oil and lubricants, which would be insignificant sources of emissions.

In addition, there would be two diesel-fired fire pump engines, each rated at approximately 525 hp. Potential emissions from the platform fire pump engines are based on 500 hours per year of operation each, at 100 percent load. However, during routine operation the fire pump engines would only run for 30 minutes of testing per week.

The vent stack located on the platform mooring dolphins would safely vent regasified LNG from various GasPort components in the event of an emergency upset condition, resulting in emissions of CH_4 and VOC. However, during normal operation all residual LNG vapors that need to be cleared from piping or other components would be recaptured and vented back into the FSRU and/or LNG carrier cargo tanks. The only non-emergency use of the vent stack would be for a once-yearly purge of the platform equipment to allow for maintenance, resulting in a very small amount of emissions. These emissions are based on the total volume of gas contained in the piping, as determined by Excelerate Energy, along with typical values for the density, CH_4 content, and VOC content of regasified LNG. (No short-term emission rate exists for this intermittent activity.)

LNG Carrier Unloading

The Project would be capable of accepting LNG deliveries from any of several hundred LNG carriers operating in the worldwide fleet, ranging in cargo capacity from 163,500 to 283,800 yd^3 (125,000 to 217,000 m^3). These vessels are powered predominantly by steam boilers or by DFDE engines, with a variety of models and ratings. Potential emissions from LNG carriers are calculated based on the following assumptions.

- An average year-round natural gas send out rate of 500 MMscf/day from the FSRU, which corresponds to approximately 50 cargo deliveries from a "typical" LNG carrier with 39 million gallons (151,000 m^3) of cargo capacity. Each delivery from a "typical" LNG carrier is assumed to take approximately 30 hours.

- Two different types of LNG carrier propulsion systems were considered: steam turbine boilers fired with oil and boil-off gas; and medium-speed DFDE vessels which have the capability of firing either dual fuel (99 percent boil-off gas, 1 percent oil) or oil.

- For each pollutant, g/kWh emission factors were developed for each type of propulsion system, based on the following three fuel use scenarios: steam turbine firing 1/3 residual oil and 2/3 boil-off gas; steam turbine firing 100 percent boil-off gas; and DFDE firing 100 percent distillate oil. The worst-case emission rate for each pollutant was then selected to determine short-term and annual emissions.

- LNG would be unloaded at a rate of 1.3 million gallons per hour (5,000 m^3/hr), at an estimated power demand of 1,560 kW. The hoteling load is assumed to be 1,900 kW for steam-driven LNG carriers, and 3,000 kW for DFDE-driven LNG carriers.

Based on discussions with EPA Region 2, only the portion of LNG carrier emissions that are directly related to cargo transfer are to be included as part of the Project's emissions under the PSD program. LNG carrier hoteling emissions are estimated here for disclosure purposes.

Support Vessel

A single dedicated support vessel, approximately 150 feet (46 m) in length, would transfer supplies and personnel to and from the terminal platform. The support vessel is also assumed to have two diesel generators rated at 40 kW each, and two diesel fire pump engines rated at 873 hp each. The two small diesel generators would operate 24 hours per day, and the two fire pump engines would operate for 30 minutes of testing per week. The support vessel main engines would operate for six hours per day to transfers cargo and personnel to and from shore. While emissions from the support vessel are not included as part of the facility's emission total for PSD permitting, they are estimated here for disclosure purposes.

Support Tugs

Four tugboats, each with a rated output of 5,520 hp, would each spend a total of four hours in transit at 60 percent engine load, and four hours in mooring and unmooring activities at 69 percent engine load, for each LNG carrier that arrives at the Offshore GasPort. While emissions from the support tugs are not included as part of the facility's emissions totals for PSD permitting, they are estimated here for disclosure purposes.

Table 4.10.1-7 presents annual potential emissions for the Project.

Project Best Management Practices

In response to federal and local requirements, BMPs have been included in Project design or proposed by Aguirre LLC to reduce environmental impacts. Potential impacts of air emissions from Project operations would be reduced by incorporation of operating restrictions and use of emission reduction technologies on the FSRU to limit pollutant emissions. Project design for the offshore boilers include only combusting natural gas as fuel and the use of SCR technology for the boilers to achieve controlled NO_x and ammonia slip levels at 15 ppm and 10 ppm, respectively. These measures employ proven technology and would reduce the potential impacts of the Project on air quality.

Air Quality Impact Assessment

Offshore and Coastal Dispersion Model Analysis

The Offshore and Coastal Dispersion (OCD) model was used to assess the air quality concentrations for all criteria pollutants from the Project for comparison with the NAAQS. This analysis evaluates the Offshore Gasport's stationary emission sources as well as the transitory emission sources including the tug boats and other support vessels moving within the safety zone, and the LNG carriers moving to and from the Offshore GasPort and under hoteling conditions within the safety zone. The OCD model is the model recommended by EPA for sources located over water and it uses meteorological data from both over-land and over-water weather stations.

Meteorological Data for OCD

The OCD model uses hourly over-land and over-water meteorological data to simulate the plume transport and dispersion for shoreline conditions. Data from land-based monitoring stations and water-based buoy monitoring stations representative of site conditions were input to the OCD model.

TABLE 4.10.1-7

Annual Potential Emissions (tpy [mtpy]) for the Aguirre Offshore GasPort Project

Source	NO_x	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	CO_2e
Boiler 1 boil-off gas (8,760 hrs)	17.8 (16.1)	21.7 (19.7)	1.0 (0.9)	7.3 (6.6)	7.3 (6.6)	0.6 (0.5)	114,648 (104,007)
Boiler 2 boil-off gas (8,760 hrs)	17.8 (16.1)	21.7 (19.7)	1.0 (0.9)	7.3 (6.6)	7.3 (6.6)	0.6 (0.5)	114,648 (104,007)
Boiler 1 Heavy Fuel Oil (696 hrs)	1.6 (1.5)	0.1 (0.1)	0.02 (0.02)	0.4 (0.4)	0.3 (0.3)	4.5 (4.1)	1,375 (1,247)
Boiler 2 Heavy Fuel Oil (696 hrs)	1.6 (1.5)	0.1 (0.1)	0.02 (0.02)	0.4 (0.4)	0.3 (0.3)	4.5 (4.1)	1,375 (1,247)
Boiler 1 Cold start-up Heavy Fuel Oil (48 hrs)	0.9 (0.8)	0.01 (0.01)	0.003 (0.003)	0.09 (0.08)	0.07 (0.06)	0.9 (0.8)	282 (256)
Boiler 2 Cold start-up Heavy Fuel Oil (48 hrs)	0.9 (0.8)	0.01 (0.01)	0.003 (0.003)	0.09 (0.08)	0.07 (0.06)	0.9 (0.8)	282 (256)
Boiler 1 Burner lighting (183 hrs)	0.4 (0.4)	0.45 (0.41)	0.02 (0.02)	0.25 (0.23)	0.22 (0.20)	1.2 (1.1)	2,767 (2,510)
Boiler 2 Burner lighting (183 hrs)	0.4 (0.4)	0.45 (0.41)	0.02 (0.02)	0.25 (0.23)	0.22 (0.20)	1.2 (1.1)	2,767 (2,510)
Boiler 1 (Worst case annual total)	18.8 (17.1)	21.7 (19.7)	1.0 (0.9)	7.3 (6.6)	7.1 (6.4)	7.1 (6.4)	115,021 (104,345)
Boiler 1 (Worst case annual total)	18.8 (17.1)	21.7 (19.7)	1.0 (0.9)	7.3 (6.6)	7.1 (6.4)	7.1 (6.4)	115,021 (104,345)
Aux Boiler (worst case)	12.7 (11.5)	30.9 (28.0)	0.7 (0.6)	5.2 (4.7)	5.2 (4.7)	0.4 (0.4)	81,566 (73,995)
Diesel Generator (worst case)	17.2 (15.6)	18.0 (16.3)	4.4 (4.0)	0.5 (0.5)	0.5 (0.5)	0.5 (0.5)	2,339 (2,176)
Platform Engine 1 (NG)	4.5 (4.1)	9.1 (8.3)	3.2 (2.9)	0.15 (0.13)	0.15 (0.13)	0.012 (0.012)	2,338 (2,121)
Platform Engine 2 (NG)	4.5 (4.1)	9.1 (8.3)	3.2 (2.9)	0.15 (0.13)	0.15 (0.13)	0.012 (0.012)	2,338 (2,121)
Platform Engine 3 (distillate oil)	0.2 (0.2)	0.2 (0.2)	0.06 (0.05)	0.01 (0.01)	0.01 (0.01)	0.004 (0.004)	547 (496)
Platform Engine 4 (distillate oil)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Platform Fire Pump 1	0.7 (0.6)	0.2 (0.2)	0.1 (0.1)	0.02 (0.02)	0.02 (0.02)	0.001 (0.001)	148 (134)
Platform Fire Pump 2	0.7 (0.6)	0.2 (0.2)	0.1 (0.1)	0.02 (0.02)	0.02 (0.02)	0.001 (0.001)	148 (134)
Fugitive Methane	N/A	N/A	N/A	N/A	N/A	N/A	220 (200)
Venting Emission	N/A	N/A	0.003 (0.003)	N/A	N/A	N/A	1 (0.9)
LNG Carrier Unloading (worst case)	31.2 (28.3)	11.8 (10.7)	2.0 (1.8)	0.5 (0.5)	0.4 (0.4)	5.8 (5.3)	2,139 (1,940)
LNG Carrier Hoteling, including safety zone movements and idling at berth (worst case)	60.0 (54.4)	22.7 (20.6)	3.9 (3.5)	0.94 (0.85)	0.84 (0.76)	7.0 (6.4)	5,297 (4,805)
Support Vessel	72.5 (65.8)	19.3 (17.3)	1.9 (1.7)	2.3 (2.1)	2.3 (2.1)	0.04 (0.04)	3,706 (3,362)
LNG Carrier Tugs (X4)	63.8 (57.9)	16.9 (15.3)	1.6 (1.5)	2.0 (1.8)	2.0 (1.8)	2.1 (1.9)	3,262 (2,959)
FSRU Misc. Engines	0.5 (0.5)	0.08 (0.07)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.0001 (0.0001)	15 (14)
Facility Totals	**354.4 (321.5)**	**200.0 (181)**	**26.1 (23.7)**	**27.1 (24.6)**	**26.5 (24.0)**	**35.7 (32.4)**	**334,579 (303,525)**

Note: The numbers in this table have been rounded for presentation purposes. As a result, the conversions may not be exact in all cases.

Ozone Limiting Method NO_2 Calculations

EPA guidance on 1-hour NO_2 dispersion modeling (*Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard, March 1, 2011*) describes a three-tiered screening approach for modeling 1-hr NO_2 Concentrations. Preliminary modeling indicated that the 1-hour NO_2 concentrations from all of the Project sources, using either the Tier 1 or Tier 2 approach, would result in unrealistically high predicted concentrations. Both Tier 1 and Tier 2 can predict overly conservative (high) NO_2 concentrations, in that actual atmospheric conversion processes are not adequately taken into account. Therefore, Tier 3, known as Ozone Limiting Method, was utilized to provide more realistic (but still conservative) estimates of the maximum 1-hour NO_2 concentrations.

Offshore GasPort Emission Source Parameters

The OCD dispersion model impact analysis evaluated the Offshore GasPort's stationary emission sources (FSRU sources, platform sources, and LNG carrier unloading) as well as the LNG carriers hoteling emissions and the transitory emission sources operating within the safety zone (tug boats, other support vessels, and the LNG carriers moving to and from the GasPort platform within the safety zone). The emission sources parameters used for the OCD dispersion modeling analysis are presented in table 4.10.1-8.

OCD Model Results

The OCD-predicted impact concentrations for the Offshore GasPort are presented in table 4.10.1-9. Since a single year (2011) of meteorological data was used from the nearby Jobos Bay Reserve (JOXP4) meteorological monitoring station, maximum predicted impact concentrations (rather than second highest or 98 percentile concentrations) were conservatively used in the NAAQS compliance assessment. Total modeled concentrations plus ambient background concentrations are less than all corresponding NAAQS. Therefore, the operation of the Offshore Gasport is not expected to cause or contribute to a violation of any of the NAAQS and would not have a significant impact on air quality.

Based on the analysis above and the proposed mitigation measures, we conclude that operation of the Project would not result in significant impacts on air quality.

GHG Emission Impacts

For assessment of the Project's GHG impact and potential significance, emissions were compared to data from the EPA Greenhouse Gas Reporting Program, which received GHG emission reports from about 8,000 facilities in 2011, covering all 50 states plus the District of Columbia, Guam, Puerto Rico, and the U.S. Virgin Islands (EPA, 2013). Twenty-eight of these reporting facilities were in Puerto Rico, and included most of the island's major power plants as well as a number of landfills (which are major emitters of CH_4, a potent GHG) and several other industrial facilities. The total GHG emissions reported in 2011 from these 28 Puerto Rico facilities was 18,540,844 tons (16,819,970 metric tons) of GHG mass, or 55,577,807 tons (50,419,338 metric tons) when converted to CO_2e. The future annual potential emissions from the GasPort component of the Project are equal to 0.6 percent of Puerto Rico's reported GHG emissions for 2011; therefore, the relative impact and potential significance of the Project's potential GHG emissions is very small in comparison to other existing emission sources.

Fugitive CH_4 emissions from leaking valves, pump seals, connectors, and flanges on both the FSRU and the terminal platform are based on facility component counts, and assume that one percent of components are leaking. The EQB may require a Leak Detection and Repair Program for these fugitive CH_4 emissions. Emission rates for leaking components are based on emission factors in 40 CFR 98 Subpart W for LNG import and export equipment.

TABLE 4.10.1-8

OCD Model Emissions and Exhaust Parameters for Offshore GasPort Modeled Sources

Source Description	NO_x (lb/h [g/s])	CO (lb/h [g/s])	PM_{10} / $PM_{2.5}$ (lb/h [g/s])	SO_2 (lb/h [g/s])	Stack Height (ft [m])	Stack Temp (F[K])	Stack Diameter (ft [m])	Exit Velocity (ft/s [m/s])	Stack Angle (Deg)	Grd-level Elev (ft [m])
Boiler 1 [a]	4.9 (0.62)	5.0 (0.63)	1.7 (0.21)	3.1 (0.39)	122.7 (37.4)	352 (451)	4.6 (1.4)	69.6 (21.2)	45	0.0
Boiler 2 [a]	4.9 (0.62)	5.0 (0.63)	1.7 (0.21)	3.1 (0.39)	122.7 (37.4)	352 (451)	4.6 (1.4)	69.6 (21.2)	45	0.0
Auxiliary Boiler [b]	2.9 (0.37)	7.1 (0.89)	1.2 (0.15)	0.1 (0.012)	122.7 (37.4)	392 (473)	4.6 (1.4)	68.2 (20.8)	45	0.0
DFDE Generator [c]	11.5 (1.45)	29.3 (3.69)	0.2 (0.03)	0.2 (0.03)	122.7 (37.4)	626 (603)	2.3 (0.7)	93.8 (28.6)	45	0.0
Platform Engine Gas 1 [d]	1.0 (0.13)	2.1 (0.26)	0.0 (0.0043)	0.0 (0.00034)	20.0 (6.1)	892 (751)	0.7 (0.2)	122.0 (37.2)	0	52.5 (16.0)
Platform Engine Gas 2 [d]	1.0 (0.13)	2.1 (0.26)	0.0 (0.0043)	0.0 (0.00034)	20.0 (6.1)	892 (751)	0.7 (0.2)	122.0 (37.2)	0	52.5 (16.0)
Platform Engine Oil 1 [d]	0.2 (0.026)	0.2 (0.0198)	0.0 (0.0013)	0.0 (0.00047)	20.0 (6.1)	899 (755)	0.7 (0.2)	91.2 (27.8)	0	52.5 (16.0)
LNG Carrier Steam Turbine Unloading + Hoteling [e]	N/A	N/A	N/A	17.1 (2.16)	122.7 (37.4)	320 (433)	4.6 (1.4)	15.1 (4.6)	45	0.0
LNG Carrier Steam Turbine Safety Zone + Idling [f]	N/A	N/A	N/A	1.3 (0.16)	122.7 (37.4)	311 (428)	4.6 (1.4)	8.2 (2.5)	45	0.0
LNG Carrier Medium-speed Dual-fuel Diesel (MSD) Unloading + Hoteling [g]	121.7 (15.33)	46.0 (5.8)	1.9 (0.24)	N/A	122.7 (37.4)	682 (634)	4.6 (1.4)	35.1 (10.7)	45	0.0
LNG Carrier MSD Safety Zone + Idling [h]	11.0 (1.38)	4.1 (0.52)	0.2 (0.02)	N/A	122.7 (37.4)	682 (634)	4.6 (1.4)	23.0 (7.0)	45	0.0
Support Vessel + Tugs (20% of total mass emissions) [i]	6.2 (0.78)	1.7 (0.21)	0.2 (0.025)	0.1 (0.012)	19.7 (6.0)	590 (583)	2.3 (0.7)	65.6 (20.0)	45	0.0
Support Vessel + Tugs (40% of total mass emissions) [i]	12.5 (1.57)	3.3 (0.42)	0.4 (0.049)	0.2 (0.024)	19.7 (6.0)	590 (583)	2.3 (0.7)	65.6 (20.0)	45	0.0
Support Vessel + Tugs (40% of total mass emissions) [i]	12.5 (1.57)	3.3 (0.42)	0.4 (0.049)	0.2 (0.024)	19.7 (6.0)	590 (583)	2.3 (0.7)	65.6 (20.0)	45	0.0

[a] Boilers 1 and 2 emissions are average annualized emission rates based on 7,833 hours on boil-off gas, 696 hours on heavy fuel oil, 183 hours of burner lightings, and 48 hours of start-up.

[b] Auxiliary boiler emissions are average annualized emission rates based on 8,724 hours on boil-off gas and 36 hours of start-up.

[c] DFDE generator emissions are based on maximum hourly emissions under normal dual fuel operation.

[d] Platform engine emissions are based on maximum hourly emissions.

[e] LNG Carrier steam turbine unloading and hoteling emissions are based on maximum hourly emissions of the steam turbine propulsion LNG carriers at berth (higher than MSD emissions for SO_2).

[f] LNG Carrier steam turbine safety zone and idling emissions are based on annual average emissions for operation of the steam turbine propulsion LNG carriers within the safety zone (higher than MSD emissions for SO_2).

[g] LNG Carrier MSD unloading and hoteling emissions are based on maximum hourly emissions of the medium speed diesel propulsion LNG carriers at berth (higher than steam turbine emissions for NO_x, CO, and particulate matter).

[h] LNG Carrier MSD safety zone and idling emissions are based on annual average emissions for operation of the medium speed diesel propulsion LNG carriers within the safety zone (higher than steam turbine emissions for NO_x, CO, and particulate matter).

[i] Support Vessel and Four Tug emissions assume three locations along the platform, one location for the support vessel, and two locations with two co-located tugs each.

Notes: g/s = grams per second; m = meter; K =Kelvin; m/s= meters per second; Deg= degree. The numbers in this table have been rounded for presentation purposes. As a result, the conversions may not be exact in all cases.

TABLE 4.10.1-9 **OCD Model Results for All Aguirre GasPort Project Sources Combined with Ambient Background for Comparison with NAAQS**					
Pollutant	Averaging Period	Maximum Predicted OCD concentration [$\mu g/m^3$]	Ambient Background ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
CO	1-hour	147.8	18,370	18,517.8	40,000
CO	8-hour	96.4	4,846	4,942.4	10,000
NO_2	1-hour	128.9	56.4	185.3	188
NO_2	Annual	16.3	27.5	43.8	100
$PM_{2.5}$	24-hour	5.0	18.2	23.2	35
$PM_{2.5}$	Annual	1.1	6.2	7.3	12
PM_{10}	24-hour	5.0	77.5	82.5	150
SO_2	1-hour	42.6	50.7	93.3	196
SO_2	3-hour	36.6	38.3	74.9	1300
SO_2	24-hour	17.5	33.3	50.8	365
SO_2	Annual	3.0	11.0	14.0	80

4.10.2 Noise

This section describes the potential noise effects associated the Project. Noise is expected to be generated during both construction and operation of the Project. The potential effects of both in-air and underwater sound are considered. Refer to Section 4.5.3.3 for a discussion on the hydro acoustic (underwater) impacts of the Project. The following sections discuss in-air sound, existing conditions and regulations, and how noise generated from the construction and operation of the Project may contribute to the acoustic environment and means to mitigate impacts on NSAs where necessary.

4.10.2.1 Principles of Noise

Sound is a sequence of waves of pressure that propagates through compressible media such as air or water. When sound becomes excessive, annoying, or unwanted, it is referred to as noise. Decibels are the units of measurement used to quantify the intensity of noise. To account for the human ear's sensitivity to low level noises the decibel values are corrected to weighted values known as decibels on the A-weighted scale (dBA). Table 4.10.2-1 shows the relative dBA noise levels of common sounds measured in the environment and industry.

The equivalent sound level (L_{eq}) is the preferred single value figure to describe sound levels that vary over time, it is defined as the sound pressure level of a noise fluctuating over a period of time, expressed as the amount of average energy. The 24-hour average A-weighted equivalent sound level of the measured daytime L_{eq} and nighttime L_{eq} is known as the day-night noise level (L_{dn}). For the L_{dn}, 10 dB are added to the sound levels occurring during the nighttime hours of 10PM to 7AM to account for the increased sensitivity of people to nighttime noise and the typically quieter ambient conditions during this time period.

TABLE 4.10.2-1

Sound Pressure Levels and Relative Loudness

Noise Source or Activity	Sound Level (dBA)	Subjective Impression	Relative Loudness (perception of different sound levels)
Jet aircraft takeoff from carrier (50 feet)	140	Threshold of pain	64 times as loud
50-hp siren (100 feet)	130		32 times as loud
Loud rock concert near stage / Jet takeoff (200 feet)	120	Uncomfortably loud	16 times as loud
Float plane takeoff (100 feet)	110		8 times as loud
Jet takeoff (2,000 feet)	100	Very loud	4 times as loud
Heavy truck or motorcycle (25 feet)	90		2 times as loud
Garbage disposal / Food blender (2 feet) / Pneumatic drill (50 feet)	80	Loud	Reference loudness
Vacuum cleaner (10 feet)	70	Moderate	1/2 as loud
Passenger car at 65 mph (25 feet)	65		
Large store air-conditioning unit (20 feet)	60		1/4 as loud
Light auto traffic (100 feet)	50	Quiet	1/8 as loud
Quiet rural residential area with no activity	45		
Bedroom or quiet living room / Bird calls	40	Faint	1/16 as loud
Typical wilderness area	35		
Quiet library, soft whisper (15 feet)	30	Very quiet	1/32 as loud
Wilderness with no wind or animal activity	25	Extremely quiet	
High quality recording studio	20		1/64 as loud
Acoustic test chamber	10	Just audible	
	0	Threshold of hearing	

Source: Barnes and Laymon, 1977 and EPA, 1971.

[a] Noise sources or activities with no information in the subjective impression column have been included to demonstrate the doubling effect between 10 dBA intervals.

4.10.2.2 Regulatory Requirements

Regulations or ordinances were identified that would be applicable to the Project under the FERC and the EQB. The following noise limits are understood to apply to all normal operations of the Project and are further described in the following subsections.

Federal

The Health and Welfare with an Adequate Margin of Safety (EPA, 1974) publication evaluates the effects of environmental noise with respect to health and safety. The document provides information for state and local governments to use in developing their own ambient noise standards. The EPA has determined that in order to protect the public from activity interference and annoyance outdoors in residential areas, noise levels should not exceed an L_{dn} of 55 dBA. We have adopted this criterion (18 CFR 157.206(b)(5)) for new compression and associated pipeline facilities, and it is used here to evaluate the potential noise affects from operation of the Offshore GasPort. An L_{dn} of 55 dBA is equivalent to a continuous noise level of 48.6 dBA for facilities that operate at a constant level of noise.

Regulations (18 CFR 380.12(k)) require that the noise attributable to any new installation (i.e., new compressor stations and associated pipeline facilities or other FERC-jurisdictional facilities) at any preexisting NSA, unless such NSAs are established after facility construction, be quantified. NSAs include schools, hospitals, and residences. Other federal regulations that pertain to noise beyond the immediate work environment include the Noise Emission Standards for Construction Equipment in 40 CFR 204 and Noise Emission Standard for Transportation Equipment in 40 CFR 205.

State and Local

In accordance with the Public Environmental Policy Act (Act Number 416 of September 22, 2004), the EQB has enacted regulations with the primary purpose of establishing standards to minimize damage to the environment and to establish checkpoints for activities that produce pollution. In 2001, the Legislature of Puerto Rico approved the Noise Prohibition Act as a regulation to eliminate noise pollution harmful to the health or welfare of the residents of the Commonwealth of Puerto Rico and establish clear aquatic noise level criteria. This act identifies the EQB as the main local agency for the enforcement of noise regulations on the island. The EQB Regulation 3418 for the Control of Noise Pollution (Reglamento para el Control de la Contaminación por Ruidos de la Junta de Calidad Ambiental, versión enmendada 2011) contains established standards and requirements for the control, reduction, or elimination of noise that might be harmful to health and disrupt public welfare. The EQB noise regulation prescribes noise emission limits for different receptor zones, noise emissions levels from motor vehicles, and procedures relating to noise level measurements. The EQB noise level limits applicable to the Project are summarized in table 4.10.2-2.

TABLE 4.10.2-2

Puerto Rico Environmental Quality Board Noise Emission Limits (dBA)

	Receiving Land Use Type							
	Zone I Residential		Zone II Commercial		Zone III Industrial		Zone IV Tranquility	
Emitting Source	Day	Night	Day	Night	Day	Night	Day	Night
Zone I	60	50	65	55	70	60	55	50
Zone II	65	50	70	60	75	65	55	50
Zone III	65	50	70	65	75	75	55	50
Zone IV	65	50	70	65	75	75	55	50

For the purposes of this acoustic assessment, all NSAs (with the exception of NSA 6, which is unclassified) were assumed to be located within receiving land use type Zone I which corresponds to residential. This assumption results in a conservative assessment approach as the noise emission limits for receptors in Zone I are the most stringent limits as prescribed by the EQB for NSAs located within the study area, with a nighttime limit of 50 dBA. There are no Zone IV receiving land use types classified as areas of tranquility identified within the acoustic study area. As the Project may operate at any time during the day or night, the more stringent nighttime permissible sound level becomes the controlling limit for the future operational condition.

According to EQB regulation, adjustments to the regulatory noise limits are allowable depending on the levels of existing background noise. Allowable adjustments to the EQB noise regulation are defined as follows:

- if existing (ambient) sound levels are less than the EQB noise level limits by more than 10 dBA, then no adjustment to the limits are made;

- if the difference between the EQB noise level limits and the existing (ambient) sound levels is between 6 and 10 dBA, then 1 dBA is added to the noise levels limits;

- if the difference between the EQB noise level limits and the existing (ambient) sound levels is between 3 and 6 dBA, then 2 dBA are added to the noise levels limits; and

- if the difference between the EQB noise level limits and the existing (ambient) sound levels is between 0 and 6 dBA, then 3 dBA are added to the noise levels limits.

The EQB also provides guidance on noise generated during construction activities. The regulation restricts the use and operation of construction equipment or the performing of demolition work that generates noise exceeding the applicable limits as prescribed in table 4.10.2-4, except in an emergency situation or if a waiver is obtained from the EQB for special circumstances.

4.10.2.3 Existing Ambient Noise Conditions

A baseline sound survey was completed to document the existing ambient in-air sound levels in proximity to select NSAs within the Project area. An inventory of receptors within a radius of about 5 miles (8 km) of the proposed Offshore GasPort was completed prior to the baseline survey. A field reconnaissance and ambient noise survey was conducted over a four-day period from April 23 to April 26, 2012. Meteorological conditions during the measurement program were conducive to accurate data collection with an average temperature of 80 °F (27 °C), relative humidity of 81 percent, and low wind speeds of less than 8 mph (13 km/hr) predominantly from the eastward direction.

The measurement locations were selected to be representative of NSAs nearest to the Project in the principal onshore geographical directions. NSAs can include areas and buildings such as schools, hospitals, parks, and residences. Six NSAs were identified with two to the north, one northwest, two northeast and one east of the GasPort site at ranges varying 1.7 to 4.6 miles (2.7 to 7.4 km). The locations of the baseline sound monitoring stations and distances to the proposed Project are shown on figure 4.10.2-1. Below is a brief description of each NSA:

- **NSA 1:** Las Mareas is a residential waterfront neighborhood within the Town of Salinas.

- **NSA 2:** Mondesoria 1 is a residential waterfront neighborhood located adjacent to the Aguirre Plant and also within the Town of Salinas.

- **NSA 3:** This is a residential tri-community of San Philippe, Chunchin, and Mosquito and spans both the Towns of Salinas and Guayama.

- **NSA 4:** This monitoring location in the community of Punta Pozuelo at a restaurant "Villa Pesquera," which has a boat launch and parking area on-site for water vessels.

- **NSA 5:** This monitoring location is in a residential waterfront neighborhood of Punta Pozuelo within the Town of Guayama.

- **NSA 6:** This monitoring location is situated on Isle de Education, also known as "Cayos Caribes."

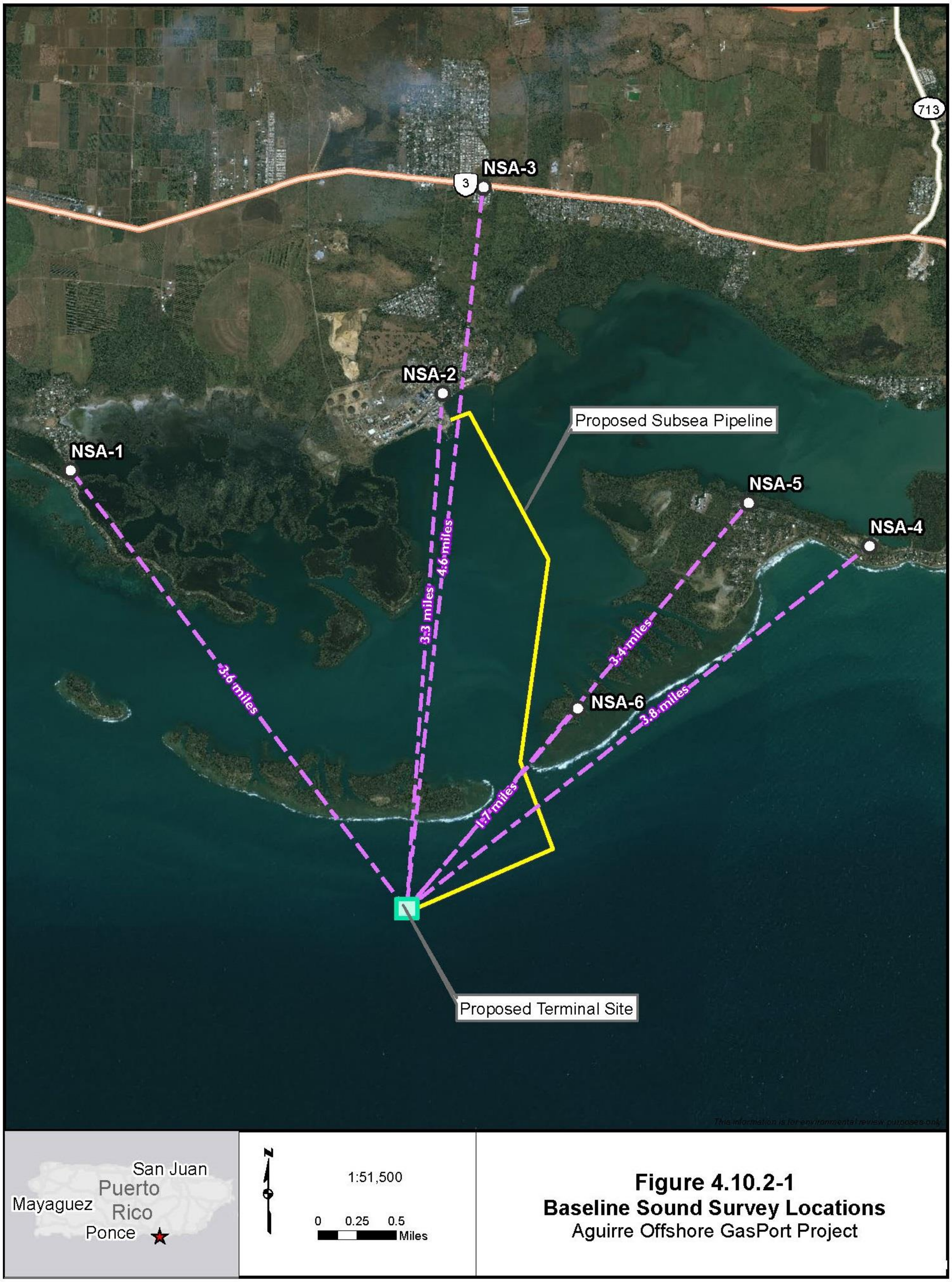


Figure 4.10.2-1
Baseline Sound Survey Locations
Aguirre Offshore GasPort Project

Table 4.10.2-3 summarizes the results of the baseline sound survey. Where present, extraneous sound energy generated by seasonal frogs and/or insects was extracted, resulting in a more conservative assessment of baseline sound levels.

TABLE 4.10.2-3

Summary of Daytime and Nighttime Baseline Sound Measurement Results

Monitoring Location				Sound Level Metrics (dBA)		
NSA	Location/Community	Distance to the Offshore Terminal Site (miles [km])	Time Period	L_{eq}	L_{10}	L_{dn}
1	Las Mareas	3.6 (5.8)	Day	44	46	47
			Night [a]	40	43	
2	Mondesoria	3.3 (5.3)	Day	64	65	70
			Night	64	65	
3	San Philippe, Chunchin, Mosquito	4.6 (7.4)	Day	56	59	56
			Night	45	47	
4	Punta Pozuelo	3.8 (6.1)	Day	48	52	53
			Night [a]	46	47	
5	Punta Pozuelo	3.4 (5.5)	Day	46	51	49
			Night [a]	41	45	
6	Isle de Education	1.7 (2.7)	Day	55	56	N/A [b]
			Night [b]	N/A [b]	N/A [b]	

[a] Extraneous sound from frogs and/or insects extracted from nighttime measurement data.
[b] Nighttime observations were not conducted at NSA 6 due to the lack of access by boat during the nighttime hours (Tetra Tech, 2013b).

The results of the baseline sound survey show that sound levels vary depending in part on location and exposure to existing sound sources. The measured L_{dn} noise levels ranged from 47 dBA (at NSA 1) to 70 dBA (at NSA 2). NSA 2 is adjacent to the existing Aguirre Plant; therefore, the higher measured sound levels during daytime and nighttime are expected due to the prominent noise-generating equipment at that location. The results of the baseline sound survey at the other NSAs show similar L_{eq} and L_{dn} sound levels, indicating a relative acoustic homogeneity across the Project area, with NSAs exposed to both similar sources and overall background sound levels.

4.10.2.4 Construction Noise Impact and Mitigation

Potential impacts from the Project may result in short-term noise effects during construction of the offshore berthing platform and longer-term effects due to operation of the Project. In-air acoustic modeling was conducted for the Project in order to assess the potential noise impacts associated with construction and operation.

The installation of pipelines and the platform would require a number of different types of vessels including crane barges, shallow water lay barge, pipe transport barges, dive support vessels, vessel support tugs, and crew/supply boats. Tugs and work boats would be used to maneuver barges. In general, vessels with high-powered engines that use thrusters tend to generate higher levels of sound than vessels without these types of propulsion systems. There would be no thruster-enabled vessels in use within Jobos Bay during Project construction. Thruster enabled vessels may be required during terminal construction but have not been considered in the acoustic analysis, due to the comparatively larger distance between the proposed terminal facilities site and the nearest NSA.

Piles to secure the pipe lay barge would be driven with vibratory pile driving equipment for all piles within Jobos Bay. In addition, piles would be required to fix the berthing facilities at the Offshore

GasPort to the seabed. The use of impact hammers may be necessary for installation of the terminal facilities but have not been formally addressed, pending further review of the geological information for confirmation. Vibratory pile installation and removal of the temporary piles is estimated to produce sound levels of 78 dBA at a distance of approximately 400 feet (122 m).

The subsea pipeline would be installed in five segments, with segment end points defined by PIs along the pipeline. Each segment would be fabricated on shallow water pipe lay barges that would be secured to the bottom with spud-legs or temporary piles. The model simulation assumes a total of five construction positions located at the PIs. If an HDD were found to be feasible, the HDD equipment would generate additional noise during construction. The primary sound generated during HDD activities are from the diesel engines that power the drilling equipment. If the pipeline under the Boca del Infierno pass was constructed by HDD, Aguirre LLC would be required to demonstrate that the noise impacts on the nearest NSAs attributable to the HDD operations would not exceed an L_{dn} of 55 dBA.

The modeling conservatively assumed that all sources would be operating simultaneously and at or near full load conditions, and that they would be all the same distance from a given NSA (i.e., all co-located within approximately 1 mile [1.6 km]). However, during actual construction, some of the intermittent sources (tug, work boat, and barge equipped mechanical equipment) would not operate concurrently and would be somewhat more dispersed within a given area. Estimated noise levels during offshore construction and vibratory pile driving are in table 4.10.2-4.

TABLE 4.10.2-4

Noise Levels During Offshore Construction and Vibratory Pile Driving Based on Worst Case Position

NSA	Location/Community	Existing Ambient L_{dn} Noise Levels (dBA)	Construction Activities (dBA)	Vibratory Pile Driving (dBA)	FERC Criteria (dBA)	EQB Noise Emission Daytime Limits (dBA)
1	Las Mareas	47	30	42	55	65/50
2	Mondesoria	70	66	71	55	68/53 [a]
3	San Philippe, Chunchin, Mosquito	56	37	44	55	65/50
4	Punta Pozuelo	53	33	43	55	65/50
5	Punta Pozuelo	49	38	46	55	65/50
6	Isle de Education	N/A	50	59	55	65/50 [b]

[a] If the difference between the EQB noise level limits and the existing (ambient) sound levels is between 0 and 6 dBA, then 3 dBA are added to the noise level limits.

[b] The island does not fall within any given EQB classification as it is presently undeveloped but is used for recreational purposes; therefore, EQB limits for residential receptors has been used for this assessment.

The acoustic modeling results indicate that noise levels would vary at NSA locations as the activities move nearer or farther from the shoreline. Aguirre LLC would consult with the EQB to develop the appropriate mitigation measures should actual sound levels measured during construction activities exceed the nighttime EQB noise limits. These mitigation measures could include establishing appropriate work hours and development of a Construction Noise Abatement Plan where Aguirre LLC would monitor onshore sound levels in the vicinity of active pipeline construction. If sound levels at residential areas onshore do not meet EQB criteria for an extended time, noise mitigation measures would be adjusted appropriately.

Although construction of the Project would exceed our criteria of an L_{dn} of 55 dBA, the noise impacts on the NSAs would be short-term and temporary. Based on the noise analysis above and Aguirre LLC's commitment to consult with the EQB on appropriate noise mitigation measures during construction, we conclude that adjacent NSAs would not be significantly affected by construction-related noise.

4.10.2.5 Operational Noise Impact and Mitigation

Figure 4.10.2-2 presents the prototype EBRV *Excelsior* and areas of principal sound emission. In order to evaluate sound levels generated from operation during regasification and transit, sound data were previously collected during extensive field studies conducted of the prototype EBRV in the Gulf of Mexico. In-air sound measurements were collected from an observation vessel in the vicinity of the *Excelsior* EBRV. Measurements were also collected during *Excelsior* EBRV on station and operating in the open-loop regasification and send out mode. The FSRU for the Project would be subject to International Maritime Organization standards for noise emissions.

Figure 4.10.2-2: Prototype EBRV Excelsior and Areas of Principal Sound Emission

The main sound sources of an EBRV acting as an FSRU at berth are the generator exhausts including main and auxiliary boilers and generators; mechanical ventilation for the engine room; regasification devices; and LNG discharge equipment. Sound levels were quantified for typical EBRV mechanical sounds including aft of the gas discharge and offloading/regasification operations through the turret connection located forward and through the control arm extending from the ship. During normal operating conditions, process pipework, gas metering and the gas analyzer system would be the potential noise sources. During periods of pressure equalization, gas control valves, and the gas heater system would also be active. Pressurization and/or depressurization of a vessel are aided by pressure equalization devices which typically include valves and controls. The result of the pressure equalization process can be noise.

The platform would also include switchgear, transformers, and motor control centers as needed to distribute power throughout the facility. The electrical equipment would be housed in a climate controlled switch room. There are no landside components that are directly associated with the Project that would generate noise during normal operations.

Acoustic modeling was completed for operational conditions when: (1) the FSRU is moored but no regasification is being conducted (i.e., standby); and (2) the FSRU is conducting regasification and discharge offloading and an LNG carrier is present conducting LNG transfer. Under Scenario 1 (vessel standby), it is expected that only the main boiler would be operating at 40 percent load to generate electrical power onboard the vessel. Under Scenario 2, it was assumed that both main and auxiliary boilers would be operating under maximum load to provide full power to regasification mechanical and process equipment.

The acoustic modeling analysis focuses on normal operations and not atypical emergency or upset conditions; however, special attention was paid to periods of pressure equalization. The contribution of the pressure equalization to noise levels at any NSA would be limited to a maximum of 48 dBA, which allows for a small design tolerance and maintaining conformance with the most stringent 50 dBA nighttime limit imposed by the EQB regulations. Pressure equalization activities would be expected to occur once or twice per year, with pressure equalization venting and support equipment in operation for approximately 30 to 60 minutes on average per event.

Predicted noise level results from major equipment proposed for the Offshore GasPort and applicable permissible noise limits are summarized in table 4.10.2-5.

As shown in table 4.10.2-5, the calculated Project-related noise contributions would range from 14 to 37 dBA L_{dn} at the representative NSAs. Table 4.10.2-5 also demonstrates that operational noise levels would be the highest under Scenario 2; however, all noise levels during operation of the Offshore GasPort would be below our criteria of 55 dBA L_{dn} at the nearest NSAs as well as EQB's more stringent nighttime permissible noise level. However, to ensure that the Project operates in compliance with our guidelines, specifically under Scenario 2, **we recommend that:**

- **Aguirre LLC should file a noise survey with the Secretary <u>no later than 60 days</u> after placing the Aguirre Offshore GasPort Project in service. If a full load condition noise survey is not possible, Aguirre LLC should provide an interim survey at the maximum possible load and provide the full load survey <u>within 6 months</u>. If the noise attributable to operation of the Offshore GasPort under interim or full load conditions exceeds an L_{dn} of 55 dBA at any nearby NSAs, Aguirre LLC should file a report on what changes are needed and should install additional noise controls to meet the level <u>within 1 year</u> of the in-service date. Aguirre LLC should confirm compliance with the above requirement by filing a second noise survey <u>no later than 60 days</u> after it installs the additional noise controls.**

Based on the results of the noise analysis and our recommendations, we conclude that operation of the Project would have no significant impact on the noise environment in the Project area.

TABLE 4.10.2-5

Calculated Operational Noise from the Aguirre Offshore GasPort Project

NSA	Location	Existing L_{dn} (dBA)	FERC Perm. Noise Limit (dBA)	EQB Permissible Noise Level Day (dBA)	EQB Permissible Noise Level Night (dBA)	Calculated Operational Sound Level (dBA) Scen. 1 [a]	Calculated Operational Sound Level (dBA) Scen. 2 [b]	Calculated L_{dn} of Proposed Noise Sources (dBA) Scen. 1 [a]	Calculated L_{dn} of Proposed Noise Sources (dBA) Scen. 2 [b]	Estimated Incremental Increase of Cumulative Sound Levels (dBA) Scen. 1 [a]	Estimated Incremental Increase of Cumulative Sound Levels (dBA) Scen. 2 [b]
1	Las Mareas	47		65	50	12	15	20	24	<1	<1
2	Mondesoria	70		65	50	15	18	24	27	<1	<1
3	San Philippe, Chunchin, Mosquito	56	55	65	50	5	9	14	18	<1	<1
4	Punta Pozuelo	53		65	50	11	14	19	23	<1	<1
5	Punta Pozuelo	49		65	50	12	16	21	24	<1	<1
6	Isle de Education	N/A [c]		N/A [d]	N/A [d]	25	28	34	37	N/A [c]	N/A [c]

[a] FSRU Standby Mode.
[b] LNG Transfer and Regasification.
[c] Nighttime observations were not conducted at NSA 6 due to the lack of access by boat during the nighttime hours (Tetra Tech, 2013b).
[d] The island does not fall within any given EQB classification because it is presently undeveloped but is used for recreational purposes.

4.11 RELIABILITY AND SAFETY

The transportation of natural gas involves some incremental risk to the public due to the potential for an accidental release of natural gas. The greatest hazard is a fire or explosion following a major pipeline rupture or LNG carrier spill. However, it is also important to recognize that there are stringent requirements for the design, construction, operation, and maintenance of marine terminals and that there would be extensive safety systems in place to detect and control potential hazards associated with the proposed Project.

4.11.1 Regulatory Agencies

Two federal agencies share regulatory authority over the siting, design, construction, and operation of LNG import terminals located offshore: the USCG and the FERC. The USCG regulates the safety of an LNG facility's marine transfer area and LNG marine traffic, and regulates security plans for the entire LNG facility and LNG marine traffic. Those standards are codified in 33 CFR 105 and 127. In addition, the LNG vessels and the FSRU would be subject to 46 CFR 154, which are the safety standards for self-propelled vessels carrying bulk liquefied gases. Under the Natural Gas Act and delegated authority from the DOE, the FERC authorizes the siting and construction of LNG import and export facilities.

In February 2004, the USCG and FERC entered into an Interagency Agreement to ensure greater coordination among these two agencies in addressing the full range of safety and security issues at LNG terminals, including terminal facilities and tanker operations, and maximizing the exchange of information related to the safety and security aspects of the LNG facilities and related marine operations. Under the Interagency Agreement, the FERC is the lead federal agency responsible for the preparation of the analysis required under NEPA for impacts associated with terminal construction and operation. The USCG participates as a cooperating agency. Both agencies have some oversight and responsibility for inspection and compliance during the facility's operation.

FERC and USCG staff are evaluating the proposed facility on multiple design standards, including appropriate portions of the NFPA's Standard 59A (NFPA 59A), an industry consensus safety standard for the design and operation of on-shore LNG facilities. In conjunction with this, the USCG would also determine the suitability of the Project Waterway for LNG marine traffic by issuing a Letter of Recommendation (see section 4.11.7.1).

As part of the review required for a FERC authorization, we must ensure that the Offshore GasPort would be able to operate safely and securely. The design information that must be filed in the application to the Commission is specified by 18 CFR § 380.12 (m) and (o). The level of detail necessary for this submittal requires the Project sponsor to perform substantial front-end engineering of the proposed facilities. The design information is required to be site-specific and developed to the extent that further detailed design would not result in changes to the siting considerations, basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs which we considered during our review process.

The following sections contain the conclusions of our reliability and safety analysis and incorporate comments of the USCG as a cooperating agency. In accordance with 33 CFR 127, the USCG has provided FERC with a LOR regarding the suitability of the waterway for LNG carrier traffic.

4.11.2 Hazards

The principal hazards associated with the storage and vaporization of LNG result from loss of containment, vapor dispersion characteristics, flammability, and the ability to produce damaging overpressures. A loss of the containment provided by the LNG cargo tanks or process piping would result in the formation of flammable vapor near the release location, as well as near LNG that pooled. Releases occurring in the presence of an ignition source would most likely result in a fire located at the vapor source. A spill without ignition would form a vapor cloud that would travel with the prevailing wind until it either dispersed below the flammable limits or encountered an ignition source. In some instances, ignition of a vapor cloud may produce damaging overpressures. These hazards are described in more detail below.

Loss of Containment

A loss of the containment is the initial event that results in all other potential hazards. The initial loss of containment can result in an LNG and/or gaseous release with the formation of vapor at the release location, as well as from any liquid that pooled. LNG released may present low or high temperature hazards, and may result in the formation of flammable vapors. The extent of the hazard will depend on the storage and process conditions and the volumes released.

LNG would be stored in cargo tanks on the FSRU at atmospheric pressure and at a cryogenic temperature of approximately –260 °F. Loss of containment of LNG could lead to the release of both liquid and vapor on the FSRU or into the water surrounding the FSRU. Exposure to either cold liquid or vapor could cause freeze burns and, depending on the length of exposure, more serious injury or death. However, spills would be limited to the area adjacent to the Offshore GasPort and the cold state of these releases would be greatly limited due to the continuous mixing with the warmer air and surrounding water. The cold temperatures from the release would not present a hazard to the public, which would not have access to areas up to 500 yards from the Offshore GasPort as discussed in the LOR section (see 4.11.7.1).

LNG is a cryogenic liquid that would quickly cool any materials contacted by the liquid on release, causing extreme thermal stress in materials not specifically designed for such conditions. These thermal stresses could subsequently subject the material to brittleness, fracture, or other loss of tensile strength. These temperatures, however, would be accounted for in the design of the LNG cargo tanks and process equipment on the FSRU as well as the process piping on the Offshore GasPort. This would not be substantially different from the hazards associated with the storage and transportation of liquid oxygen (–296 ºF) or several other cryogenic liquids that have been routinely produced and transported in the United States.

A rapid phase transition (RPT) can occur when a cryogenic liquid is spilled onto water and changes from liquid to gas, virtually instantaneously. Unlike an explosion that releases energy and combustion products from a chemical reaction, an RPT is the result of heat transferred to the liquid inducing a change to the vapor state. RPTs have been observed during LNG test spills onto water. In some test cases, the overpressures generated were strong enough to damage test equipment in the immediate vicinity of the LNG release point. The sizes of the overpressure events have been generally small and are not expected to cause significant damage. The average overpressures recorded at the source of the RPTs during the Coyote tests have ranged from 0.2 to 11 psi.[14] These events are typically limited to the area within the spill and are not expected to cause damage outside of the area engulfed by the LNG pool. However, a RPT may affect the rate of pool spreading and the rate of vaporization rate for a spill on water.

Vapor Dispersion

In the event of a loss of containment, LNG would vaporize when released from any storage or process facilities. Depending on the size of the release, LNG may form a liquid pool and vaporize. Additional vaporization would result from exposure to ambient heat sources, such as water or the platform. When released from a containment vessel or transfer system, LNG will generally produce 620 to 630 standard cubic feet of natural gas for each cubic foot of liquid.

If the loss of containment does not result in immediate ignition of the natural gas vapors, the vapor cloud would travel with the prevailing wind until it either encountered an ignition source or dispersed below its flammable limits. An LNG release would form a denser-than-air vapor cloud that would sink to the ground due to the cold temperature of the vapor. As the LNG vapor cloud disperses downwind and mixes with the warm surrounding air, the LNG vapor cloud may become buoyant. As a result, estimating the dispersion of the vapor cloud is an important step in addressing potential hazards and will be discussed in section 4.11.4.

Methane, the primary component of LNG, is classified as a simple asphyxiate and may pose extreme health hazards, including death, if inhaled in significant quantities within a limited time. Very cold CH_4 vapors may also cause freeze burns. However, the locations of concentrations where cold temperatures and oxygen-deprivation effects could occur are greatly limited due to the continuous mixing with the warmer air surrounding the spill site. Exposure injuries from contact with releases of CH_4 normally represent negligible risks to the public.

Vapor Cloud Ignition

Flammability of the LNG vapor cloud would be dependent on the concentration of the vapor when mixed with the surrounding air. In general, higher concentrations within the vapor cloud would exist near the spill, and lower concentrations would exist near the edge of the cloud as it disperses

[14] The Lawrence Livermore National Laboratory conducted seven tests (the Coyote series) on vapor cloud dispersion, vapor cloud ignition, and RPTs at the Naval Weapons Center in China Lake, California in 1981.

downwind. Mixtures occurring between the lower flammability limit (LFL) and the upper flammability limit (UFL) can be ignited. Concentrations above the UFL or below the LFL would not ignite.

The LFL and UFL for CH_4 are approximately 5 and 15 percent by volume in air, respectively. If the flammable portion of a vapor cloud encounters an ignition source, a flame would propagate through the flammable portions of the cloud. In most circumstances, the flame would be driven by the heat it generates. This process is known as a deflagration. An LNG vapor cloud deflagration in an uncongested and unconfined area travels at slower speeds and does not produce significant pressure waves. However, exposure to this LNG vapor cloud fire can cause severe burns and death, and can ignite combustible materials within the cloud. Confined and congested CH_4 vapor clouds may produce higher flame speeds and overpressures, and are discussed later in this section under "Overpressures."

A deflagration may propagate back to the spill site if the vapor concentration along this path is sufficiently high to support the combustion process. When the flame reaches vapor concentrations above the UFL, the deflagration could transition to a fireball and result in a pool or jet fire back at the source. A fireball would occur near the source of the release and would be of a relatively short duration compared to an ensuing jet or pool fire.

The extent of the affected area and the severity of the impacts on objects either within an ignited cloud or in the vicinity of a pool fire would primarily be dependent on the quantity and duration of the initial release, the surrounding terrain, and the environmental conditions present during the dispersion of the cloud. Radiant heat and dispersion modeling are discussed in section 4.11.4.

Overpressures

If the deflagration in a flammable vapor cloud accelerates to a sufficiently high rate of speed, pressure waves would be generated. As a deflagration accelerates to super-sonic speeds, larger pressure shock waves are produced, and a shock wave is created. This shock wave, rather than the heat, would begin to drive the flame, resulting in a detonation. Deflagrations or detonations are often characterized more generally as explosions when the rapid movement of the flame and pressure waves associated with them cause additional damage. The amount of damage an explosion causes is dependent on the amount the pressure wave is above atmospheric pressure (i.e. an overpressure) and its duration (i.e., pulse). For example, a 1-psi overpressure is often cited as a safety limit in regulations and is associated with glass shattering and traveling with velocities high enough to lacerate skin. Flame speeds and overpressures are primarily dependent on the reactivity of the fuel, the ignition strength and location, the degree of congestion and confinement of the area occupied by the vapor cloud, and the flame travel distance.

The potential for unconfined LNG vapor cloud detonations was investigated by the USCG in the late 1970s at the Naval Weapons Center in China Lake, California. Using CH_4, the primary component of natural gas, several experiments were conducted to determine whether unconfined LNG vapor clouds would detonate. Unconfined CH_4 vapor clouds ignited with low-energy ignition sources (13.5 joules), produced flame speeds ranging from 12 to 20 mph. These flame speeds are much lower than the flame speeds associated with a deflagration with damaging overpressures or a detonation.

To examine the potential for detonation of an unconfined natural gas cloud containing heavier hydrocarbons that are more reactive, such as ethane and propane, the USCG conducted further tests on ambient-temperature fuel mixtures of methane-ethane and methane-propane. The tests indicated that the addition of heavier hydrocarbons influenced the tendency of an unconfined natural gas vapor cloud to detonate. Natural gas with greater amounts of heavier hydrocarbons would be more sensitive to detonation.

Although it has been possible to produce damaging overpressures and detonations of unconfined LNG vapor clouds, the LNG proposed for importation to the Project would have lower ethane and propane concentrations than those that resulted in damaging overpressures and detonations. The substantial amount of initiating explosives needed to create the shock initiation during the limited range of vapor-air concentrations also renders the possibility of detonation of these vapors at an LNG plant as unrealistic. As discussed in the "Vapor Dispersion" and "Vapor Cloud Ignition" sections above, the primary hazards to the public from an LNG spill that disperses to an unconfined area would be from dispersion of the flammable vapors or from radiant heat generated by a pool fire.

Ignition of a confined LNG vapor cloud could result in higher overpressures. In order to prevent such an occurrence, measures are taken to mitigate the vapor dispersion and ignition into confined areas, such as buildings. Discussion of these hazards and potential mitigation are in section 4.11.3.

4.11.3 Technical Review of the Preliminary Engineering Design

Operation of the proposed Offshore GasPort poses a potential hazard that could affect the public safety if strict design and operational measures to control potential accidents are not applied. The primary concerns are those events that could lead to an LNG spill of sufficient magnitude to create an off-site hazard as discussed in section 4.11.2. However, it is important to recognize the stringent requirements in place for the design, construction, operation, and maintenance of the facility, as well, as the extensive safety systems proposed to detect and control potential hazards.

In general, we consider an acceptable design to include multiple protection systems or safeguards to reduce the risk of a potentially hazardous scenario from developing into an event that could impact the off-site public. These layers of protection should be independent of one another so that each could perform its function regardless of the action or failure of any other protection layer or initiating event. Such design features and safeguards typically include:

- a facility design that prevents hazardous events through the use of suitable materials of construction; operating and design limits for process piping, process vessels, and storage tanks; adequate design for wind, flood, seismic, and other outside hazards;
- control systems, including monitoring systems and process alarms, remotely-operated control and isolation valves, and operating procedures to ensure the facility stays within the established operating and design limits;
- safety-instrumented prevention systems, such as safety control valves and emergency shutdown systems, to prevent a release if operating and design limits are exceeded;
- equipment protection systems, such as pressure relief valves, proper equipment and building spacing, appropriate electrical area classification, spill control, and structural fire protection, to prevent escalation to a more severe event;
- emergency response, including hazard detection and control equipment, firewater systems, on-site fire-fighting personnel and equipment, and coordination with local first responders to mitigate the consequences of a release and prevent it from escalating to an event; and
- site security measures for controlling access to the facility, including security inspections and patrols; response procedures to any breach of security and liaison with local law enforcement officials.

We find that the inclusion of such protection systems or safeguards in a facility design would minimize the potential for an initiating event to develop into an incident that could impact the safety of the public. In addition, proper siting of the facility with regard to potential consequences can be further used to minimize impacts on public safety. The siting requirements for the Project are discussed in section 4.11.4.

As self-propelled vessels carrying LNG as a bulk cargo, both the FSRU and the visiting LNG carriers would be under the jurisdiction of the USCG, rather than FERC (see Non-Jurisdictional Facilities in section 1.4). These vessels would be subject to 46 CFR 154 which require foreign-flagged vessels to receive a Certificate of Compliance (COC) from the USCG prior to calling on a United States port. Issuance of a COC is contingent upon USCG review and inspection to ensure that the vessel meets U.S. requirements for the following:

- hull structure;
- cargo tank and containment systems;
- piping systems;
- pump and compressors;
- electrical equipment;
- instrumentation; and
- hazard detection and firefighting systems.

The FSRU to be stationed at the offshore berthing platform would be from Excelerate Energy's existing fleet of eight ships. Several of Excelerate Energy's vessels have already been in operation in the United States as LNG import terminals as Deepwater Ports subject to regulation by the U.S. Maritime Administration and the USCG. The design, construction, and operation of the FSRU and LNG carriers, which are not subject to FERC jurisdiction and have already been reviewed and accepted by the USCG, were not included in our engineering review.

As part of its application, Aguirre LLC provided a FEED for the Offshore GasPort. In developing the FEED, Aguirre LLC conducted a Hazard Identification and Operability Study (HAZID/HAZOP) to identify potential risk scenarios. The HAZID/HAZOP studies address hazards of the process, engineering and administrative controls, and provides a qualitative evaluation of a range of possible safety, health, and environmental effects which may result from the design or operation of the facility. Recommendations to prevent or minimize these hazards are generated from the results of the HAZID/HAZOP reviews. These studies help establish the required safety control levels and identify whether additional process and safety instrumentation, mitigation, and/or administrative controls would be needed. In addition, a HAZOP review of the completed design would be performed by Aguirre LLC's design development team during the detailed design phase.

As part of our review of the Project, we analyzed the information filed by Aguirre LLC to determine the extent that layers of protection or safeguards were included. Our review focused on the engineering design and safety concepts of the various protection layers, as well as the projected operational reliability of the proposed facilities. The design would use materials of construction suited to the pressure and temperature conditions of the process design. Piping would be designed in accordance with American Society of Mechanical Engineers (ASME) B31.3. Pressure vessels would be designed in accordance with ASME Section VIII and NFPA 59A.

The facility would also be designed to withstand the effects of hurricane force winds. The FSRU would leave the Offshore GasPort before the wind speed reaches 68.2 mph (109 km/hr). The design wind velocity for hurricanes on the platforms, superstructures, and equipment after the FSRU departs the Offshore GasPort would be 150 mph (241 km/hr) (sustained) and 179 mph (288 km/hr) (3-second gust).

The current estimate of the 500-year wave crest height at the Offshore GasPort site is 44.8 feet (13.7 m) above mean sea level. We also examined the seismic and structural design of the facility and provided recommendations to mitigate issues identified as detailed in sections 4.1.3 and 4.1.4.

Aguirre LLC would install process control valves and instrumentation to safely operate and monitor the facility. Alarms would have visual and audible notification in the control room to warn operators that process conditions may be approaching design limits. Operators would have the capability to take action from the control room to mitigate an upset. Aguirre LLC would develop facility operations procedures after completion of the final design; this timing is fully consistent with accepted industry practice. We are recommending that Aguirre LLC provide the operating and maintenance procedures as they are developed, as listed later in this section. In addition, we are recommending measures such as labeling of instrumentation and valves (i.e., car-seals and/or locked valves) to address human error and improve facility safety. An alarm management program would also be in place to ensure effectiveness of the alarms.

Safety valves and instrumentation would be installed to monitor, alarm, shutdown, and isolate equipment and piping during process upsets or emergency conditions. Safety instrumented systems would comply with International Society for Automation Standard 84.01. As listed below, we are also including recommendations on the design, installation, and commissioning of instrumentation and emergency shutdown equipment to ensure appropriate cause and effect alarm or shutdown logic and enhanced representation of the emergency shutdown valves in the facility control system. This would ensure that the design includes sufficient safeguards to react to process upsets and hazardous conditions.

Safety relief valves and vent stacks would be installed to protect the process equipment and piping. The safety relief valves would be designed to handle process upsets and thermal expansion within piping, per NFPA 59A and would be designed based on API 520 and 521. As listed below, we are including recommendations to ensure the pressure relief valves would be sufficiently sized for major process equipment and vessels.

In the event of a release, LNG and process facilities would be provided with a spill system designed to direct a spill to a low point and into the sea. A continuous deck wash would be operating on the Offshore GasPort during LNG transfer operations to direct any LNG spills down and avoid LNG contact with the substructure.

Aguirre LLC performed a preliminary fire protection evaluation to ensure that adequate hazard detection, hazard control, and firewater coverage would be installed to detect and address any upset conditions. Structural fire protection, proposed to prevent failure of structural supports of equipment and pipe racks, would comply with NFPA 59A. Aguirre LLC would also install hazard detection systems to detect, alarm, and alert personnel in the area and control room to initiate an emergency shutdown and/or initiate appropriate procedures and would meet NFPA 72. Hazard control devices would be installed to extinguish or control incipient fires and releases, and would meet NFPA 59A, 10, and 12. Aguirre LLC would provide automatic firewater systems and monitors for use during an emergency to cool the surface of piping and equipment exposed to heat from a fire, mitigate potential cryogenic contact with the hull side of the ship, and prevent migration of a vapor cloud into the utility area or the control room. These firewater systems would meet NFPA 59A, 15, 20, and 24 requirements. We are recommending that Aguirre LLC provide more information on the design, installation, and commissioning of hazard detection, hazard control, and firewater systems as Aguirre LLC would further develop this information during the final design phase. We would review this information to confirm that the final design, installation, and capabilities of the hazard detection and control equipment would be consistent with the equipment proposed in the application.

Aguirre LLC would also have emergency procedures in accordance with 33 CFR 127. The emergency procedures would provide for protection of personnel and the public as well as the prevention of property damage that may occur as a result of incidents at the facility. Aguirre LLC would also be required to develop an ERP in accordance with Energy Policy Act of 2005, as discussed further in section 4.11.8.

As part of the FEED, Aguirre LLC has proposed to continuously man the Offshore GasPort. In order to minimize the risk of an intentional event, Aguirre LLC would provide lighting, camera systems, and intrusion detection to deter, monitor, and detect intruders onto the facility. These systems would be supported by backup power supplies. Aguirre LLC would be required to develop a Facility Security Plan in accordance with the USCG's regulations found in 33 CFR 105, Subpart D. These regulations require all terminal owners and operators to submit a Facility Security Assessment and a Facility Security Plan to the USCG for review and approval. Some of the responsibilities of the applicant include, but are not limited to:

- designating an Facility Security Officer with a general knowledge of current security threats and patterns, risk assessment methodology, and the responsibility for implementing the Facility Security Assessment and Facility Security Plan and performing an annual audit for the life of the Project;
- conducting a Facility Security Assessment to identify site vulnerabilities, possible security threats and consequences of an attack, and facility protective measures;
- developing a Facility Security Plan based on the Facility Security Assessment, with procedures for:
    - responding to transportation security incidents;
    - notification and coordination with local, state, and federal authorities;
    - prevention of unauthorized access; measures and equipment to prevent or deter dangerous substances and devices;
    - training; and
    - evacuation;
- implementing scalable security measures to provide increasing levels of security at increasing maritime security levels for facility access control, restricted areas, cargo handling, vessel stores and bunkers, and monitoring;
- ensuring the Transportation Worker Identification Credential program is properly implemented; and
- reporting all breaches of security and security incidents to the National Response Center.

Under 33 CFR 105 Aguirre LLC would need to submit a Facility Security Plan to the USCG for review and approval before commencement of operations. The Facility Security Plan would specify measures that have the capability to continuously monitor the facility's security through a combination of lighting, security guards, waterborne patrols, automatic intrusion-detection devices, or surveillance equipment.

We conclude the use of these protection layers would minimize the potential for an initiating event to develop into an incident that could impact the safety of the off-site public. As a result of our technical review of the information provided by Aguirre LLC in its application, we did identify a number of concerns in an information data request letter issued on October 9, 2013. Aguirre LLC provided written responses to the information data request on October 29, 2013. Below, we have included recommendations based on our review of the proposed design filed in the application and the information filed in response to our information request.

The FEED and specifications submitted for the proposed facilities to date are preliminary, but would serve as the basis for any detailed design to follow. If authorization is granted by the Commission, the next phase of the Project would include development of the final design, including final selection of equipment manufacturers, process conditions, and resolution of some safety-related issues. It is unlikely that the detailed design information to be developed would result in changes to the basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs which were presented as part of Aguirre LLC's FEED.

Prior to finalizing the design as "Issued for Construction," a more detailed and thorough HAZOP would be performed by Aguirre LLC. These studies would further refine the required safety control levels and identify whether additional process and safety instrumentation, mitigation, and/or administrative controls would be needed. Aguirre LLC would evaluate these changes to ensure that the safety, health, and environmental risks arising from these changes are addressed and controlled. Resolutions of the recommendations generated by the HAZOP review would be monitored by the FERC staff. We have included a recommendation that Aguirre LLC should file a hazard and operability study on the completed final design.

Information regarding the development of the final design, as detailed below, would need to be reviewed by FERC staff before equipment construction at the site would be authorized. To ensure the final design would be consistent with the safety and operability characteristics identified in the FEED, **we recommend that the following measures should apply to Aguirre LLC's Offshore GasPort. Information pertaining to these specific recommendations should be filed for review and written approval by the Director of OEP either: <u>prior to any construction</u>; <u>prior to construction of final design</u>; <u>prior to commissioning</u>; <u>prior to introduction of hazardous fluids</u>; or <u>prior to commencement of service</u>, as indicated by each specific condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 683 (Docket No. RM06-24-000), including security information, should be submitted as critical energy infrastructure information (CEII) pursuant to 18 CFR 388.112. See Critical Energy Infrastructure Information, Order No. 683, 71 FR 58,273 (October 3, 2006), FERC Stats. & Regs. 31,228 (2006). Information pertaining to items such as: offsite emergency response; procedures for public notification and evacuation; and construction and operating reporting requirements, will be subject to public disclosure. All information should be filed a minimum of 30 days before approval to proceed is requested.**

- **<u>Prior to construction</u>, Aguirre LLC should file the quality assurance and quality control procedures for construction activities.**
- **<u>Prior to any construction</u>, Aguirre LLC should file an overall Project schedule, which includes the proposed stages of the commissioning plan.**
- **<u>Prior to construction</u>, Aguirre LLC should file a plot plan (area layout drawings) of the final design showing all major equipment, structures, buildings, and spill control systems.**

- **The final design should provide a technical review of its proposed facility design that:**

a. **identifies all combustion/ventilation air intake equipment and the distances to any possible hydrocarbon release (LNG, flammable refrigerants, flammable liquids, and flammable gases); and**

b. **demonstrates that these areas are adequately covered by hazard detection devices and indicate how these devices would isolate or shutdown any combustion equipment whose continued operation could add to or sustain an emergency.**

- **The final design should include change logs that list and explain any changes made from the FEED provided in Aguirre LLC's application and filings. A list of all changes with an explanation for the design alteration should be provided and all changes should be clearly indicated on all diagrams and drawings.**

- **The final design should provide up-to-date P&IDs, which include the following information:**

a. **equipment tag number, name, size, duty, capacity, and design conditions;**

b. **equipment insulation type and thickness;**

c. **valve high pressure side and internal and external vent locations;**

d. **piping with line number, piping class specification, size, and insulation type and thickness;**

e. **piping specification breaks and insulation limits;**

f. **all control and manual valves numbered;**

g. **relief valves with set points; and**

h. **drawing revision number and date.**

- **The final design should provide an up-to-date complete equipment list, process and mechanical data sheets, and specifications.**

- **The final design should provide complete drawings and a list of the hazard detection equipment. The drawings should clearly show the location and elevation of all detection equipment. The list should include the instrument tag number, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment.**

- **The final design should provide complete plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Drawings should clearly show the location by tag number of all fixed, wheeled, and hand-held extinguishers. The list should include the equipment tag number, type, capacity, equipment covered,**

discharge rate, and automatic and manual remote signals initiating discharge of the units.

- **The <u>final design</u> should provide facility plans and drawings that show the location of the firewater system. Drawings should clearly show: firewater piping and the location, and area covered by, each monitor, hydrant, deluge system, water-mist system, and sprinkler. The drawings should also include piping and instrumentation diagrams of the firewater system.**

- **The <u>final design</u> should include an updated fire protection evaluation of the proposed facilities carried out in accordance with the requirements of NFPA 59A 2013, chapter 12.2. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations should be filed.**

- **The <u>final design</u> should specify that for hazardous fluids, the piping and piping nipples 2 inches or less in diameter are to be no less than Schedule 160 for carbon steel and no less than schedule 80 for stainless steel, and are designed to withstand external loads, including operator live loads in areas accessible by operators.**

- **The <u>final design</u> should provide electrical area classification drawings.**

- **The <u>final design</u> should include a hazard and operability review of the completed design prior to issuing the P&IDs for construction. A copy of the review, a list of recommendations, and actions taken on the recommendations, should be filed.**

- **The <u>final design</u> should include the cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system. The cause-and-effect matrices should include alarms and shutdown functions, details of the voting and shutdown logic, and set points.**

- **The <u>final design</u> should include a drawing showing the location of the emergency shutdown buttons. Emergency shutdown buttons should be easily accessible, conspicuously labeled, and located in an area which would be accessible during an emergency.**

- **The <u>final design</u> should include a plan for clean-out, dry-out, purging, and tightness testing. This plan should address the requirements of the American Gas Association's Purging Principles and Practice, and should provide justification if not using an inert or non-flammable gas for cleanout, dry-out, purging, and tightness testing.**

- **The <u>final design</u> should include the sizing basis and capacity for the final design of the vent stack and pressure relief valves for major process equipment and vessels.**

- **The <u>final design</u> should provide the procedures for pressure/leak tests which address the requirements of ASME VIII and ASME B31.3.**

- **The <u>final design</u> flow rate of each firewater pump should be based on the required firewater demand.**

- **The <u>final design</u> should specify how the nitrogen purge piping to the vent stack would be used to extinguish an ignited vent.**

- **<u>Prior to commissioning</u>, Aguirre LLC should file plans and detailed procedures for: testing the integrity of onsite mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service.**

- **<u>Prior to commissioning</u>, Aguirre LLC should provide a detailed schedule for commissioning through equipment startup. The schedule should include milestones for all procedures and tests to be completed: prior to introduction of hazardous fluids; and during commissioning and startup. Aguirre LLC should file documentation certifying that each of these milestones has been completed before authorization to commence the next phase of commissioning and startup will be issued.**

- **<u>Prior to commissioning</u>, Aguirre LLC should provide tag numbers on equipment and flow direction on piping.**

- **<u>Prior to commissioning</u>, Aguirre LLC should tag all instrumentation and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves.**

- **<u>Prior to commissioning</u>, Aguirre LLC should file the operation and maintenance procedures and manuals.**

- **<u>Prior to commissioning</u>, Aguirre LLC should maintain a detailed training log to demonstrate that operating staff has completed the required training.**

- **<u>Prior to introduction of hazardous fluids</u>, Aguirre LLC should complete a firewater pump acceptance test and firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant should be shown on facility plot plan(s).**

- **<u>Prior to introduction of hazardous fluids</u>, Aguirre LLC should complete all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the Distributed Control System and the Safety Instrumented System that demonstrates full functionality and operability of the system.**

- **<u>Prior to commencement of service</u>, Aguirre LLC should file <u>monthly</u> reports of progress on the construction of the proposed systems. Details should include a summary of activities, problems encountered, contractor non-conformance/deficiency logs, remedial actions taken, and current Project schedule. Problems of significant magnitude should be reported to the FERC <u>within 24 hours</u>.**

- **<u>Prior to commencement of service</u>, Aguirre LLC should provide a plan for:**

a. **training frequency for operators;**

b. **testing frequency of facility components; and**

c. **record keeping for each training, equipment test, inspection or survey, and maintenance activity.**

In addition, **we recommend that the following measures should apply <u>throughout the life of the facility</u>:**

- **Aguirre LLC should ensure that the FSRU moored at the offshore berthing platform would be in compliance with 46 CFR 154 and should remain classed <u>throughout the life of the facility</u>.**

- **The facility should be subject to regular FERC staff technical reviews and site inspections on at least an <u>annual basis</u> or at other intervals as determined by the Director of OEP. Prior to each FERC staff technical review and site inspection, Aguirre LLC should respond to a specific data request, including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed piping and instrumentation diagrams reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted semi-annual report, should be submitted.**

- **Semi-annual operational reports should be filed with the Secretary to identify changes in facility design and operating conditions, abnormal operating experiences, activities (including ship arrivals, quantity and composition of imported LNG, vaporized quantities, boil-off/flash gas, etc.), facility modifications, including future plans and progress thereof. Abnormalities on the Offshore GasPort should include, but not be limited to: hazardous conditions in associated cryogenic piping, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), hazardous fluids releases, fires involving hazardous fluids and/or from other sources. In addition, include unloading/loading/shipping problems, potential hazardous conditions from the FSRU or LNG carriers. Adverse weather conditions and the effect on the facility also should be reported. Reports should be submitted <u>within 45 days after each period ending June 30 and December 31</u>. In addition to the above items, a section entitled "Significant Plant Modifications Proposed for the Next 12 Months (dates)" also should be included in the semi-annual operational reports. Such information would provide FERC staff with early notice of anticipated future construction/maintenance projects at the LNG facility.**

- **Significant non-scheduled events, including safety-related incidents (e.g., LNG or natural gas releases, fires, explosions, mechanical failures, unusual over pressurization, and major injuries) and security-related incidents should be reported to FERC staff. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification should be made <u>immediately</u>, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification should be made to FERC staff <u>within 24 hours</u>. This notification practice should be incorporated into the LNG facility's**

emergency plan. Examples of reportable hazardous fluids related incidents include:

a. **fire;**

b. **explosion;**

c. **estimated property damage of $50,000 or more;**

d. **death or personal injury necessitating in-patient hospitalization;**

e. **release of hazardous fluids for five minutes or more;**

f. **unintended movement or abnormal loading by environmental causes, such as an earthquake, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes hazardous fluids;**

g. **any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes hazardous fluids;**

h. **any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes hazardous fluids to rise above its MAOP (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure limiting or control devices;**

i. **a leak in an LNG facility that contains or processes hazardous fluids that constitutes an emergency;**

j. **any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes hazardous fluids;**

k. **safety-related incidents to hazardous fluids vessels occurring at or en route to and from the LNG facility; or**

l. **an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.**

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, FERC staff would determine the need for a separate follow-up report or follow-up in the upcoming semi-annual operational report. All company follow-up reports should include investigation results and recommendations to minimize a reoccurrence of the incident.

In addition to the final design review, we would conduct inspections prior to operation and would review additional materials, including quality assurance and quality control plans, non-conformance reports, and commissioning plans to ensure that the installed design is consistent with the safety and operability characteristics of the FEED. We would also conduct inspections during operation at intervals determined by the Director of OEP to ensure that the facility would be operated and maintained in accordance with the filed design throughout the life of the facility. Based on our analysis and recommendations presented above, we conclude that the FEED for the Offshore GasPort presented by Aguirre LLC would include acceptable layers of protection or safeguards which would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the off-site public.

4.11.4 Siting Analysis

Our siting analysis to address the thermal radiation and vapor dispersion zones for the proposed Project have been calculated based on the recommended practices outlined by the Sandia National Laboratories (Sandia) and described in the report entitled, *Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water* (2004 Sandia Report). For this Project, Aguirre LLC selected the following release scenarios as inputs in the hazard modeling:

- a release from a failure of the loading arm connection that transfers LNG from the Offshore GasPort into the FSRU for 10 minutes; and

- jetting releases from process piping onboard the FSRU for 10 minutes.

Pool Formation

Due to the marine nature of the proposed Project, the analysis lacks any defined impoundment areas and the potential LNG pool size from LNG releases would be controlled by the balancing of the LNG release onto the water surface versus the amount of LNG that would be vaporized from the pool. Methods defined by the 2004 Sandia Report for determining pool sizes for LNG spilled on water were used for each LNG release scenario. Utilizing this methodology, Aguirre LLC calculated pool diameters for the release scenarios listed above. Aguirre selected a spill rate of 11,000 m^3/hr (approximately 48,000 gallons per minute) from a failure of the LNG loading arms for 10 minutes. This release would result in a 119 m (390 feet) pool diameter.

For process releases onboard the FSRU, Aguirre LLC selected releases on the LNG feed piping from the FSRU cargo tanks, the high pressure LNG feed piping to the vaporizers, and the gas export line. The LNG feed from the FSRU cargo tanks resulted in an LNG pool diameter of 2.8 m (9 feet) from a 5.08 cm (2-inch) hole on the process piping and an LNG pool diameter of 76 m (249 feet) from a full rupture on the process piping. Releases from the high pressure LNG feed to the vaporizers and the gas export line would not result in pooled LNG as the LNG release would flash and gas export line release would not result in a liquid release.

Thermal Modeling

If a large quantity of LNG is spilled in the presence of an ignition source, the resulting LNG pool fire could cause high levels of thermal radiation. Thermal radiation levels typically used for exposure analyses include (1) a low level that can be tolerated by humans long enough to allow them to move to safety without significant burn injuries (about 1,600 British thermal units per square foot per hour [BTU/ft^2-hr], or 5 kW per square meter [kW/m^2]); and (2) a high level that can cause significant injury and damage to property (about 10,000 BTU/ft^2-hr, or 32 kW/m^2). These levels were designated in the LOR Analysis as Hazard Zones 2 and 1, respectively (see section 4.11.7.1). The thermal exclusion distance calculations are based on site-specific atmospheric conditions: ambient temperature of 80 °F, a relative humidity of 77 percent, and a 15-mph wind speed. Using the LNGFIRE3 computer program model developed by the Gas Research Institute, Aguirre LLC calculated thermal radiation distances for 1,600- to 10,000-BTU/ft^2-hr (approximately 5- to 32-kW/m^2) incident flux levels from a pool resulting in a failure of the loading arm. Table 4.11.4-1 presents the results from this hazard scenario at various thermal radiation levels. Due to the location of the proposed Project, these thermal radiation distances for each zone would extend only over water and would be within Zone 1.

TABLE 4.11.4-1

Thermal Radiation Distances for the Aguirre Offshore GasPort Project

Scenario	Pool Size	Thermal Radiation Levels: 10,000 BTU/ft^2-hr (32 kW/m^2)	4,000 BTU/ft^2-hr (12.5 kW/m^2)	1,600 BTU/ft^2-hr (5 kW/m^2)
Loading Arm Failure	119 m (390 feet)	234 m (768 feet)	297 m (974 feet)	385 m (1,263 feet)

Vapor Dispersion Modeling

Flammable vapor dispersion calculations were based on an ambient temperature of 70 ºF, 50 percent relative humidity, a 4.4-m/s (9.8 mph) wind speed, atmospheric stability Class D, and a surface roughness of 0.01 m. Aguirre LLC utilized DEGADIS to calculate the flammable vapor clouds from the loading arm failure scenario. The modeling results show an unignited vapor cloud extending 2,805 m (9,203 feet) to half the lower flammability limit (½ LFL) and would be within Zone 3. These distances would extend over the barrier reef and mangrove complex of Cayos Caribe, Cayos de Barca, and Cayo Puerca, which are located to the north of the proposed facility.

Aguirre LLC utilized PHAST to model the largest unignited vapor cloud from a release onboard the FSRU. The largest unignited vapor cloud would originate from a full bore release from the gas export line. The resulting flammable vapor cloud would extend to 1,405 m (4,610 feet) to the ½ LFL and would be within Zone 3. This vapor cloud would also extend over portions of the barrier reef and mangrove complex of Cayos de Barca. As this would be a non-cryogenic release, the vapor cloud would be buoyant and would quickly lift off into the air.

4.11.5 FSRU and LNG Carriers

Since 1959, ships have transported LNG without a major release of cargo or a major accident involving an LNG vessel. There are more than 370 LNG carriers in operation routinely transporting LNG between more than 100 import/export terminals currently in operation worldwide. Since U.S. LNG terminals first began operating under FERC jurisdiction in the 1970s, there have been more than 2,600 individual LNG ship arrivals at terminals in the United States. For the past 44 years, LNG shipping operations have been safely conducted in U.S. ports and waterways.

4.11.5.1 Design and Operating Requirements

The FSRU and the LNG carriers used to import and export LNG to and from the United States are constructed and operated in accordance with the IMO's *Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk*, the SOLAS, and 46 CFR 154, which contains the U.S. safety standards for vessels carrying liquefied natural gas in bulk.

As required by the IMO's conventions and design standards, hold spaces and insulation areas on the FSRU and LNG carrier are equipped with gas detection and low temperature alarms. These devices monitor for leaks of LNG into the insulation between primary and secondary LNG cargo tank barriers. In addition, hazard detection systems also monitor the hull structure adjacent to the cargo tank, compressor rooms, motor rooms, cargo control rooms, enclosed spaces in the cargo area, specific ventilation hoods and gas ducts, and air locks.

In 1993, amendments to the IMO's *Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk* required all vessels to have monitoring equipment with an alarm facility which is activated by detection of over-pressure or under-pressure conditions within a cargo tank. In addition, cargo tanks are heavily instrumented, with gas detection equipment in the hold and inter-barrier spaces, temperature sensors, and pressure gauges. The FSRU and LNG carriers are equipped with a firewater system with the ability to supply at least two jets of water to any part of the deck in the cargo area and parts of the cargo containment and tank covers above-deck. A water spray system is also available for cooling, fire prevention, and crew protection in specific areas. In addition, certain areas of the FSRU and LNG carriers are fitted with dry chemical powder-type extinguishing systems and CO_2 smothering systems for fighting fires. Fire protection also includes the following systems:

- a water spray (deluge) system that covers the accommodation house control room and all main cargo valves;
- a traditional firewater system that provides water to fire monitors on deck and to fire stations found throughout the vessel;
- a dry chemical fire extinguishing system for hydrocarbon fires; and
- a CO_2 system for protecting machinery including the ballast pump room, emergency generators, and compressors.

All LNG vessels entering U.S. waters are required to possess a valid IMO Certificate of Fitness and either a USCG Certificate of Inspection (for U.S. flag vessels) or a USCG COC (for foreign flag vessels). These documents certify that the vessel is designed and operating in accordance with both international standards and the U.S. regulations for bulk LNG carriers under Title 46 CFR 154. The FSRU would also be required to possess a COC issued by the USCG.

Furthermore, the FSRU is classed including the ship's hull, machinery, equipment (including regasification equipment) under the survey of Bureau Veritas classification society. The classification society reviewed the FSRU's equipment and system drawings against the rules of the classification society for compliance. Certain critical equipment was inspected during the manufacturing process. The classification society surveyors also verified material certificates, traceability of materials, welding processes, destructive tests, and non-destructive tests.

The FSRU calling at the offshore berthing platform and the LNG carriers that would deliver LNG to the facility comply with various U.S. and international security requirements. The IMO adopted the *International Ship and Port Facility Security Code (ISPS Code)* in 2003. The ISPS Code requires both ships and ports to conduct vulnerability assessments and to develop security plans. The purpose of the code is to prevent and suppress terrorism against ships; improve security aboard ships and ashore; and reduce the risk to passengers, crew, and port personnel on board ships and in port areas. All LNG vessels, as well as other cargo vessels 500 gross tons and larger, and ports servicing those regulated vessels, must adhere to the IMO standards. Some of the IMO requirements for ships are as follows:

- ships must develop security plans and have a Vessel Security Officer;

- ships must have a ship security alert system. These alarms transmit ship-to-shore security alerts identifying the ship, its location, and indication that the security of the ship is under threat or has been compromised;

- ships must have a comprehensive security plan for international port facilities, focusing on areas having direct contact with ships; and

- ships may have equipment onboard to help maintain or enhance the physical security of the ship.

In 2002, the Maritime Transportation Security Act was enacted by the U.S. Congress and aligned domestic regulations with the maritime security standards of the ISPS Code and SOLAS. The resulting USCG regulations, contained in 33 CFR 104, require vessels to conduct vulnerability assessments and develop corresponding security plans. All LNG carriers servicing the facility comply with the Maritime Transportation Security Act requirements and associated regulations while in U.S. waters. The FSRU calling at the offshore berthing platform also complies with SOLAS and the ISPS Code.

4.11.6 Hazards Resulting from Accidents

A review of the history of LNG maritime transportation indicates that there has not been a serious accident at sea or in a port which resulted in a spill due to rupturing of the cargo tanks. However, insurance records, industry sources, and public websites identify a number of incidents involving LNG vessels, including minor collisions with other vessels of all sizes, groundings, minor LNG releases during cargo unloading operations, and mechanical/equipment failures typical of large vessels. Some of the more significant occurrences, representing the range of incidents experienced by the worldwide LNG vessel fleet, are described below:

- **El Paso Paul Kayser** grounded on a rock in June 1979 in the Straits of Gibraltar during a loaded voyage from Algeria to the United States. Extensive bottom damage to the ballast tanks resulted; however, no cargo was released because no damage was done to the cargo tanks. The entire cargo of LNG was subsequently transferred to another LNG vessel and delivered to its U.S. destination.

- **Tellier** was blown by severe winds from its docking berth at Skikda, Algeria in February 1989 causing damage to the loading arms and the vessel and shore piping. The cargo loading had been secured just before the wind struck, but the loading arms had not been drained. Consequently, the LNG remaining in the loading arms spilled onto the deck, causing fracture of some plating.

- **Mostefa Ben Boulaid** had an electrical fire in the engine control room during unloading at Everett, Massachusetts. The ship crew extinguished the fire and the ship completed unloading.

- **Khannur** had a cargo tank overfill into the vessel’s vapor handling system on September 10, 2001, during unloading at Everett, Massachusetts. Approximately 100 gallons of LNG were vented and sprayed onto the protective decking over the cargo tank dome, resulting in several cracks. After inspection by the USCG, the Khannur was allowed to discharge its LNG cargo.

- **Mostefa Ben Boulaid** had an LNG spill onto its deck during loading operations in Algeria in 2002. The spill, which is believed to have been caused by overflow rather than a mechanical failure, caused significant brittle fracturing of the steelwork. The vessel was required to discharge its cargo, after which it proceeded to dock for repair.

- **Norman Lady** was struck by the USS Oklahoma City nuclear submarine while the submarine was rising to periscope depth near the Strait of Gibraltar in November 2002. The 87,000 m^3 LNG vessel, which had just unloaded its cargo at Barcelona, Spain, sustained only minor damage to the outer layer of its double hull but no damage to its cargo tanks.

- **Tenaga Lima** grounded on rocks while proceeding to open sea east of Mopko, South Korea due to strong current in November 2004. The shell plating was torn open and fractured over an approximate area of 20 by 80 feet (6 to 24 m), and internal breaches allowed water to enter the insulation space between the primary and secondary membranes. The vessel was refloated, repaired, and returned to service.

- **Golar Freeze** moved away from its docking berth during unloading on March 14, 2006, in Savannah, Georgia. The powered emergency release couplings on the unloading arms activated as designed, and transfer operations were shut down.

- **Catalunya Spirit** lost propulsion and became adrift 35 miles (56 km) east of Chatham, Massachusetts on February 11, 2008. Four tugs towed the vessel to a safe anchorage for repairs. The Catalunya Spirit was repaired and taken to port to discharge its cargo.

- **Suez Matthew** grounded on the reef off Cayo Maria Langa, near Guayanilla, Puerto Rico on December 19, 2009. The ship was refloated and no damage was found to the hull.

- **Al Gharrafa** collided with a container ship, Hanjin Italy, in the Malacca Strait off Singapore on December 19, 2013. The bow of the Al Gharrafa and the middle of the starboard side of the Hanjin were damaged. Both ships were safely anchored after the incident. No loss of LNG, fatalities, or injuries were reported.

Although the history of LNG shipping has been free of major incidents, and no incidents have resulted in significant quantities of cargo being released, the possibility of an LNG spill from a vessel over the duration of the proposed Project must be considered. If an LNG spill were to occur, the primary hazard to the public would be from radiant heat from a pool fire. If an LNG release were to occur without ignition, an ignitable gas cloud could form and also present a hazard. Historically, the events most likely to cause a significant release of LNG were a vessel casualty such as:

- a grounding sufficiently severe to puncture an LNG cargo tank;
- a vessel colliding with an LNG vessel in transit;
- an LNG vessel alliding[15] with the terminal or a structure in the waterway; or
- a vessel alliding with an LNG vessel while moored at the terminal.

To result in a spill of LNG, any of the above events would need to occur with sufficient impact to breach an LNG vessel's double hull and cargo tanks. All LNG vessels used to deliver LNG to the proposed Project as well as the FSRU would have double-hull construction, with the inner and outer hulls

[15] "Allision" is the action of dashing against or striking upon a stationary object (for example, the running of one ship upon another ship that is docked) – distinguished from "collision," which is used to refer to two moving ships striking one another.

separated by about 10 feet (3 m). Furthermore, the cargo tanks are normally separated from the inner hull by a layer of insulation approximately 1-foot thick.

As a result, many grounding incidents severe enough to cause a cargo spill on a single-bottom oil tanker would be unable to penetrate both inner and outer hulls of an LNG vessel. Previous incidents with LNG vessels have primarily involved grounding, and none of these have resulted in the breach of the double hull and subsequent release of LNG cargo. The likelihood of an LNG vessel sustaining cargo tank damage in a collision would depend on several factors:

- the displacement and construction of both the struck and striking vessels;
- the velocity of the striking vessel and its angle of impact with the struck vessel; and
- the location of the point of impact.

In December 2004, the DOE released a study on the potential for an LNG vessel breach. At the request of the DOE, Sandia conducted the research and wrote the 2004 Sandia Report. The 2004 Sandia Report included an LNG cargo tank breach analysis using modern finite element modeling and explosive shock physics modeling to estimate a range of breach sizes for both credible accidental and intentional LNG spill events. Accidental breaching evaluations were based on finite element modeling of collisions of double-hulled oil tankers similar in size and design to LNG carriers. The analysis of accidental events found that groundings, collisions with small vessels, and low-speed (less than 7 knots) collisions with large vessels striking at 90 degrees could cause minor vessel damage but would not result in a cargo spill. This is due to the protection provided by the double-hull structure, the insulation layer, and the primary cargo tank of an LNG vessel (i.e., LNG carriers and FSRUs). High-speed (12 knots) collisions with large vessels striking at 90 degrees were found to potentially cause cargo tank breach areas of from 0.5 to 1.5 m^2.

The possibility of an LNG release due to an accident, such as a collision or grounding, is considered minimal. In addition, current operational procedures in use by the USCG, such as managing ship traffic, coordinating ship speeds, and active ship control in inner and outer harbors, would also further reduce the potential of LNG spill from accidental causes.

4.11.7 Hazards Resulting from Intentional Acts

The 2004 Sandia Report also analyzed credible intentional breaches on LNG carriers up to 145,000 m^3 in capacity using modern finite element modeling and explosive shock physics modeling. The events considered for credible intentional acts were based on intelligence and historical data ranging from sabotage and hijacking to other types of physical attacks. Physical attacks included those documented to have occurred to several types of international shipping vessels, including attacks with small missiles and rockets, and attacks with bulk explosives.

For intentional scenarios, the size of the cargo tank hole depends on the location of the ship and source of threat. Intentional breach areas were estimated to range from 2 to 12 m^2. In most cases, an intentional breaching scenario would not result in a nominal hole area of more than 5 to 7 m^2, which is a more appropriate range to use in calculating potential hazards from spills. These hole sizes are equivalent to circular hole diameters of 2.5 and 3 m.

The 2004 Sandia Report evaluated cascading damage due to brittle fracture from exposure to cryogenic liquid or fire-induced damage to foam insulation. While possible under certain conditions, the cascading damage was found to not likely involve more than two or three cargo tanks. Cascading events were expected to increase the fire duration but not to significantly increase the overall fire hazard.

The 2004 Sandia Report also included guidance on risk management for intentional spills, based on the findings that the most significant impacts on public safety and property exist within approximately 500 m (1,640 feet) of a spill due to thermal hazards from a fire, with lower public health and safety impacts beyond 1,600 m (5,250 feet). Large un-ignited LNG vapor releases were found to be unlikely, but could extend from nominally 2,500 m (8,200 feet) to a conservative maximum distance of 3,500 m (11,500 feet) for an intentional spill.

In 2008, the DOE released another study prepared by Sandia, entitled *Breach and Safety Analysis of Spills Over Water from Large Liquefied Natural Gas Carriers, May 2008* (2008 Sandia Report). The 2008 Sandia Report assessed the scale of possible hazards for newer LNG vessels with capacities up to 265,000 m^3. Using the same methodology as the 2004 Sandia Report, the 2008 Sandia Report concluded thermal hazard distances would be only 7 to 8 percent greater than those from vessels carrying 145,000 m^3 of LNG, due primarily to the slightly greater height of LNG above the waterline. The 2008 Sandia Report also noted the general design of the larger vessels was similar to the previously analyzed ship designs and, for near-shore facilities; the calculated breach size for intentional scenarios would remain the same. Overall, the 2008 Sandia Report maintained the same impact zones as with the smaller vessels that were analyzed in the 2004 Sandia Report.

In February 2007, the U.S. Government Accountability Office (GAO) published a report assessing several studies, including the 2004 Sandia Report, which had been conducted on the consequences of an LNG spill resulting from a terrorist attack on an LNG vessel (GAO, 2007). The GAO's panel of experts agreed that the most likely public safety impact of an LNG spill would be the radiant heat from a pool fire and suggested that further study was needed to eliminate uncertainties in the assumptions used in modeling large LNG spills on water. After the GAO report, Congress requested the DOE to further address these research needs. In May 2012, a report entitled *Liquefied Natural Gas Safety Research Report to Congress* was released and is summarized below.

DOE contracted Sandia to conduct a series of large-scale LNG fire and cryogenic damage tests to investigate the larger classes of LNG carriers with capacities up to 260,000 m^3, representative of the largest LNG vessels in operation. Sandia conducted the largest LNG pool fire tests done to date and performed advanced computational modeling and ship simulations between 2008 and 2011. As in the earlier studies, Sandia worked with marine safety, law enforcement, and intelligence agencies to assess threats and credible intentional acts. Scenarios included attacks with shoulder-fired weapons, explosives, and attacks by aircraft and other boats. Sandia identified several ranges of possible hull breaches ranging from 0.005 m^2 (Very Small) to 15 m^2 (Very Large). Based on the collected pool fire test data and the ship simulations, Sandia concluded that thermal hazard distances to the public from a large LNG pool fire was smaller, by at least 2 to 7 percent, than the results listed in the 2004 and 2008 Sandia Reports.

In order to more robustly analyze the potential for cascading failure of LNG carrier cargo tanks, Sandia use detailed vessel structural and thermal damage models to simulate the effects to an LNG carrier from a spill. For the large breaches considered, Sandia predicts that as much as 40 percent of the LNG released from the cargo tank would remain within the ship's structure. Due to both the cold temperature of the LNG and the heat from a pool fire, the LNG carrier's structural steel would be degraded. The effects could be significant enough to cause the ship to be disabled, severely damaged, and at risk of sinking.

Although LNG ship design and construction practices render simultaneous, multiple tank failures as extremely unlikely, Sandia concluded that sequential multi-tank spills may be possible. If sequential failures were to occur, they would not increase the size of the area impacted by the pool fire but could increase the duration of the fire hazards. Based on this research, Sandia concluded that use of a nominal one-tank spill, with a maximum of a three-tank spill, as was recommended in the 2004 Sandia report, is still appropriate for estimating hazard distances. Due to the similar design features between LNG carriers and the FSRU (i.e., double hull construction with approximately 10-feet separation, insulation between the inner hull and the cargo tanks, etc.), Sandia's conclusion would also apply to the FSRU. Aguirre LLC utilized the Sandia recommended breach for a near-shore facility of 5-m^2 hole on the FSRU and calculated an LNG pool diameter of 270 m (886 feet). This pool size compares to the 290 m (951 feet) pool size calculated in the 2008 Sandia Report. Therefore the Hazard Zones described in section 4.11.7.1 would apply to both the LNG carriers and the FSRU.

4.11.7.1 Regulatory Requirements for LNG Carrier Operations

The USCG exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under Executive Order 10173; the Magnuson Act (50 USC 191); the Ports and Waterways Safety Act of 1972, as amended (33 USC 1221, et seq.); and the Maritime Transportation Security Act of 2002 (46 USC 701). The USCG is responsible for matters related to navigation safety, carrier engineering and safety standards, and all matters pertaining to the safety of facilities or equipment located in or adjacent to navigable waters up to the last valve immediately before the receiving tanks. The USCG also has authority for LNG Facility Security Plan review, approval, and compliance verification as provided in 33 CFR 105.

The USCG regulations in 33 CFR 127 apply to the marine transfer area of waterfront facilities between the LNG vessel and the first manifold or valve located inside the containment. 33 CFR 127 regulates the design, construction, equipment, operations, inspections, maintenance, testing, personnel training, firefighting, and security of LNG waterfront facilities. The safety systems, including communications, emergency shutdown, gas detection, and fire protection, must comply with the regulations in 33 CFR 127. Under 33 CFR § 127.019, Aguirre LLC would be required to submit two copies of its Operations and Emergency Manuals to the USCG COTP for examination at least 30 days prior to the first LNG transfer..

Both the USCG regulations under 33 CFR 127 and FERC regulations under 18 CFR § 157.21, require an applicant who intends to build an LNG import facility to submit a Letter of Intent (LOI) to the USCG at the same time the pre-filing process is initiated with the Commission. Consequently, Aguirre LLC initially notified the USCG that it proposed to construct an LNG receiving terminal located outside of Jobos Bay near Central Aguirre along the south coast of Puerto Rico and submitted an LOI to the COTP, Sector San Juan, on December 20, 2011.

As required by its regulations (33 CFR § 127.009), the USCG is responsible for issuing a LOR to the FERC regarding the suitability of the waterway for LNG marine traffic with respect to the following items:

- physical location and description of the facility;
- the LNG vessel's characteristics and the frequency of LNG shipments to or from the facility;
- waterway channels and commercial, industrial, environmentally sensitive, and residential areas in and adjacent to the waterway used by LNG vessels en route to the facility, within 25 km (15.5 miles) of the facility;
- density and character of marine traffic in the waterway;
- locks, bridges, or other manmade obstructions in the waterway;

- depth of water;
- tidal range;
- protection from high seas;
- natural hazards, including reefs, rocks, and sandbars;
- underwater pipes and cables; and
- distance of berthed vessels from the channel and the width of the channel.

In addition to the LOI, 33 CFR 127 and FERC regulations require each LNG project applicant to submit a WSA to the cognizant COTP no later than the start of the FERC pre-filing process. Until a facility begins operation, applicants must annually review their WSAs and submit a report to the COTP as to whether changes are required. The WSA must include the following information:

- port characterization;
- risk assessment for maritime safety and security;
- risk management strategies; and
- resource needs for maritime safety, security, and response.

On June 14, 2005, the USCG published a Navigation and Vessel Inspection Circular (NVIC) – *Guidance on Assessing the Suitability of a Waterway for Liquefied Natural Gas (LNG) Marine Traffic* (NVIC 05-05). The purpose of NVIC 05-05 was to provide the USCG COTPs/Federal Maritime Security Coordinators, members of the LNG industry, and port stakeholders with guidance on assessing the suitability of a waterway for LNG marine traffic. Since 2005, the USCG updated this guidance twice, publishing NVIC 05-08 and NVIC 01-11. The current guidance from the USCG is contained in NVIC 01-11.

Waterway Suitability Assessment

As described in 33 CFR 127 and in NVIC 01-11, the applicant develops the WSA in two phases. The first phase is the submittal of the Preliminary WSA, which begins the USCG's review process to determine the suitability of the waterway for LNG marine traffic. The second phase is the submittal of the Follow-On WSA. This document is reviewed and validated by the USCG and forms the basis for the agency's LOR to the FERC.

The Preliminary WSA provides an outline which characterizes the port community and the proposed facility and transit routes. It provides an overview of the expected major impacts LNG operations may have on the port, but does not contain detailed studies or conclusions. This document is used to start the USCG's scoping process for evaluating the suitability of the waterway for LNG marine traffic. Aguirre LLC submitted the Preliminary WSA with its LOI to the USCG on December 20, 2011.

A Follow-On WSA is required to provide a detailed and accurate characterization of the LNG facility, the LNG tanker route, and the port area. The assessment is to identify appropriate risk mitigation measures for credible security threats and safety hazards. According to NVIC 01-11, the Follow-on WSA should provide a complete analysis of the topics outlined in the Preliminary WSA. It should identify credible security threats and navigational safety hazards for the LNG marine traffic, along with appropriate risk management measures and the resources (federal, state, local, and private sector) needed to carry out those measures. Aguirre LLC consulted with the USCG Resident Inspection Office, the

Harbor Safety Committee and other port stakeholders in development of its Follow-On WSA. The Follow-On WSA was submitted to the USCG on January 10, 2014.

Hazard Zones

The Offshore GasPort would be located approximately 3 miles (4.8 km) offshore and the LNG carriers would approach the Offshore GasPort via open water transits. There is no defined waterway that would be used by LNG carriers en route or departing from the Offshore GasPort, however the pilot boarding area would be in the open ocean located 2 nautical miles (3.7 km) due South of the LNG offshore facility. The pilot boarding area is located in open waters and there would be no established population or shoreline areas along the LNG carrier route.

All three NVICs direct the use of the 2004 Sandia Report as the best available information on LNG spills. NVIC 05-08 and NVIC 01-11 also include use of the 2008 Sandia Report. Three concentric Zones of Concern, based on LNG carriers with a cargo carrying capacity up to 265,000 m^3, are used to assess the maritime safety and security risks of LNG marine traffic. Due to the similar designs of the LNG carriers and the FSRU (capacity of 150,900 m^3), these zones would also be applicable to the FSRU. The Zones of Concern are:

- Zone 1 – The area within 500 m (1,640 feet) of an LNG carrier where an LNG spill could pose a severe public safety and property hazard and could damage or significantly disrupt key assets located within that area. The outer perimeter of Zone 1 is approximately the distance to thermal hazards of 37.5 kW/m^2 (12,000 Btu/ft^2-hr) from a pool fire.

- Zone 2 – Is the area from 500 m (1,640 feet) to 1,600 m (5,250 feet) of an LNG carrier where an LNG spill would have less severe consequences for public safety, property, and key assets. The outer perimeter of Zone 2 is approximately the distance to thermal hazards of 5 kW/m^2 (1,600 Btu/ft^2-hr) from a pool fire.

- Zone 3 – The area from 1,600 m (5,250 feet) to 3,500 m (11,500 feet) from an LNG carrier where an LNG spill would have the least likelihood of severe consequences in the event that three cargo tanks are breached and a vapor cloud disperses with initial ignition at the source. The outer perimeter of Zone 3 should be considered the vapor cloud dispersion distance to the LFL from a worst case un-ignited release. Impacts on people and property could be significant if the vapor cloud reaches an ignition source and burns back to the source.

For the proposed Project, the only location where the Zones of Concern encompass any land areas is directly to the north and northeast of the Offshore Terminal site. There would be no land areas within Zone 1. A small portion of uninhabited Cayos de Barca would be within Zone 2 directly to the north of the Offshore GasPort site. Zone 3 would encompass uninhabited areas of Cayos de Barca, Cayo Puerca, and portions of Punta Colchones to the north and Cayos Caribes to the northeast. There would be no inhabited areas within Zones 1, 2, or 3. This information was considered in the USCG's LOR Analysis.

Letter of Recommendation

Once the applicant submits a complete Follow-On WSA, the USCG reviews the document to determine if it presents a realistic and credible analysis of the public safety and security implications from LNG marine traffic in the port. Finally, the USCG issues a LOR. The USCG may also prepare an LOR Analysis, which serves as a record of review of the LOR and contains detailed information along with the rationale used in assessing the suitability of the waterway for LNG marine traffic. On May 2, 2014, the

COTP issued an LOR and an LOR Analysis which summarized the USCG's recommended risk mitigation measures, as well as the port community's capabilities.

Based on the review and validation of the information contained in the Follow-On WSA and the evaluation of the waterway in consultation with a variety of port stakeholders, the COTP has determined that the Bahía de Jobos transit route would be suitable for the type and frequency of marine traffic associated with this Project. The reasons supporting the COTP's determination are outlined in the LOR Analysis and include the following mitigation measures:

1. Inbound, loaded, or partially loaded LNG carriers should only transit the waterway during daylight hours, with daylight being interpreted, in practical terms, as being able to clearly see the horizon, shoreline and receiving berths clearly under conditions of natural light.

2. A minimum of 2 miles (3.2 km) of clear visibility should be required for the movement of LNG carrier. In marginal weather conditions visibility can vary significantly along the route; the decision as to whether sufficient visibility exists, and is likely to continue to exist for the full transit, is a judgment call that would need to be made jointly between the attending pilot(s) in consultation with, and the concurrence of, the COTP.

3. Thirty knots should be the maximum sustained true wind speed, as measured on the LNG carrier, at which an inbound or outbound transit should be allowed to commence, and 25 knots gusting, during docking/undocking evolutions. As with visibility, significant variation in wind conditions can exist along the route, and the decision as to whether wind conditions permit a safe transit would be made by the attending pilot(s) in consultation with, and concurrence by, the COTP.

4. Aguirre LLC should plan and successfully conduct full mission bridge simulator training for those pilots providing services to LNG carriers. The training should take into account the full spectrum of vessel design and length, cargo carrying capacity, method of propulsion, steering and rudder configuration, thruster arrangements, and maneuvering characteristics for those carriers being considered for charter. In addition, expanded simulator training incorporating the number and design of tug boats having the minimum performance and operating criteria should be conducted.

5. Aguirre LLC should prepare and submit an Operations Manual, as required by 33 CFR § 127.305, and an Emergency Manual, as required by 33 CFR § 127.307, to the COTP for review and approval. The Operations and Emergency Manuals should be submitted at least 30 days before any transfer of LNG can take place. Comprehensive and coordinated response planning should consider:

    a. In-transit and dockside emergency procedures in the event of fire, mechanical malfunction, allision, grounding, and/or need of safe anchorage or refuge.

    b. The potential environmental impact of an LNG release and the identification and acquisition of joint resource needs to respond to the potential release.

    c. A contingency response plan specific to LNG and focusing on a layered response approach.

d. Coordinated marine firefighting training and emergency response, with an emphasis on containing and extinguishing LNG fires.

e. An incident management training and collaborative exercise program.

6. As per the enclosure (10) of NVIC 01-11, and prior to commencement of LNG operations, Aguirre LLC should provide the COTP with the following information pertaining to vessels that are reasonably anticipated to be servicing Aguirre LLC:

   a. intended LNG carriers nation of registry;

   b. the nationality or citizenship of the officers serving on board the intended LNG carriers; and

   c. the nationality or citizenship of the crew members serving on board the intended LNG carriers.

7. Until the facility goes into operation, Aguirre LLC should conduct an annual review of their WSA and provide the COTP with an update that accurately reflects all changes (actual and planned), to include changes of planned LNG carrier size or load frequency, port characterization modifications, facility-related design alternations, and conditions potentially affecting cumulative considerations. The annual review cycle should coincide with the anniversary date of the LOR.

8. Aguirre LLC should consider providing an education program directed at personnel residing or working near the proposed operation that outlines the steps Aguirre LLC operators and local emergency response organizations may take in the event of an emergency, and what the public can do to contribute to their own safety if an LNG release should occur.

9. Aguirre LLC should provide necessary data pertaining to the depth and keel clearance of the underwater pipeline. Most significantly at any area that the pipeline approaches the vicinity of the keys, entrance to Boca del Infierno pass or any other shoal areas. These areas are frequently used by local fishermen and recreational boaters. To mitigate the risk of an unintentionally grounding or anchoring, the pipeline should be mark and updated with NOAA so that is updated with the appropriate nautical charts. Areas where the keel clearance is less than 10 feet should also be properly marked to warn any vessel transiting in close proximity of the pipeline.

10. The USCG proposes to establish a moving 100-yard (91 m) safety zone for all LNG carriers entering the surrounding areas of Bahía de Jobos while on approach and departure to the Offshore GasPort. Aguirre LLC would have a fixed 500-yard (457 m) safety zone at all times. Once the LNG vessel is moored, the vessel would be part of the 500-yard (457 m) safety zone regulation.

11. As described in the Follow-On WSA, marine firefighting capabilities are limited in this region. In order to improve firefighting capabilities able to respond to Aguirre LLC and LNG carriers, it is highly recommended to retrofit another commercial tug boat with FiFi 1 equipment, which would provide a third viable resource to combat at sea fire emergencies. As stated in Section 8.2.B. of the LOR Analysis, the COTP would require at least one tug in service to any LNG carriers, or the FSRU, to have FiFi 1 capability at all times. Additionally, the Commonwealth should assess the availability of marine firefighting resources in this region and develop a strategic plan in cooperation with Aguirre LLC that addresses all potential resource shortfalls.

The USCG's LOR is a recommendation on the current status of the waterway to the FERC, the lead agency responsible for siting the proposed LNG facility. Neither the USCG nor the FERC has authority to require waterway resources of anyone other than the applicant under any statutory authority or under the Emergency Response Plan or the Cost Sharing Plan (see section 4.11.6). However, if the Project is approved and if the appropriate resources are not in place, then neither agency would allow the Project to go into operation. As the USCG recommended that additional measures beyond those proposed by Aguirre LLC in the WSA would be needed to responsibly manage the maritime safety and security risks associated with LNG marine traffic, **we recommend that:**

- **<u>Prior to commencement of service,</u> Aguirre LLC should receive written authorization from the Director of OEP for the Project. Such authorization will only be granted following a determination by the USCG, under its authorities under the Ports and Waterways Safety Act, the Magnuson Act, the Maritime Transportation Security Act of 2002, and the Safety and Accountability For Every Port Act, that appropriate measures to ensure the safety and security of the facility and the waterway have been put into place by Aguirre LLC or other appropriate parties.**

4.11.8 Emergency Response and Evacuation

While the release scenarios evaluated for the facility in sections 4.11.4 and 4.11.5 provide guidance on the extent of potential hazards, they should not be assumed to represent the evacuation zone for every potential incident. As with any other fuel or hazardous material, the actual severity of the incident would determine what area needs to be evacuated, if any, rather than a worst-case maximum zone. It is anticipated that the emergency evacuation plans would identify evacuation distances based upon increasing severity of events.

The USCG regulations in 33 CFR 127 establish requirements for the development and content of emergency response plans for waterfront LNG facilities. These plans, which are required to be developed prior to facility operation or LNG transfer from a ship, are to address the facility staff's response to onsite emergencies. For emergencies that may impact the public, the regulations contain requirements for notification, coordination, and cooperation with local officials, hospitals, fire departments, police departments, and other emergency response organizations. In addition, 15 USC 717b-1(e) stipulates that in any order authorizing an LNG terminal, the Commission shall require the LNG terminal operator to develop an ERP and Cost Sharing Plan in consultation with the USCG and state and local agencies. The NGA requires that this plan, intended to address security and safety needs at the LNG terminal and in proximity to vessels that serve the facility, be approved prior to the beginning of facility construction. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Aguirre LLC should file with the Secretary for review and written approval by the Director of OEP an ERP (including evacuation)**

and coordinate procedures with the USCG; Commonwealth and local emergency planning groups; fire departments; Commonwealth law enforcement; and appropriate federal agencies. This plan should include at a minimum:

a. **designated contacts with Commonwealth and local emergency response agencies;**

b. **scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;**

c. **procedures for notifying residents and recreational users within areas of potential hazard;**

d. **evacuation routes/methods for residents and public use areas that are within any transient hazard areas along the route of the LNG marine transit;**

e. **locations of permanent sirens and other warning devices; and**

f. **an "emergency coordinator" on each LNG vessel to activate sirens and other warning devices.**

Aguirre LLC should notify the FERC staff of all planning meetings in advance and should report progress on the development of its ERP <u>at 3-month intervals</u>.

On previous LNG import terminal proposals, a number of organizations and individuals have expressed concern that the local community would have to bear some of the cost of ensuring the security and emergency management of the LNG facility and the LNG vessels while in transit and unloading at the berth. In addition, Section 3A(e) of the NGA (as amended by the Energy Policy Act of 2005) specifies that the ERP shall include a Cost-Sharing Plan that contains a description of any direct cost reimbursements the applicants agree to provide to any Commonwealth and local agencies with responsibility for security and safety at the LNG terminal and in proximity to LNG vessels that serve the facility. Therefore, **we recommend that:**

- **<u>Prior to construction,</u> Aguirre LLC should file with the Secretary, for review and written approval by the Director of OEP, the ERP, which includes a Cost-Sharing Plan identifying the mechanisms for funding all Project-specific security/emergency management costs that would be imposed on Commonwealth and local agencies. In addition to the funding of direct transit-related security/emergency management costs, this comprehensive plan should include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base.**

The cost-sharing plan must specify what the LNG terminal operator would provide to cover the cost of Commonwealth and local resources required to manage the security of the LNG terminal and LNG vessel, and Commonwealth and local resources required for safety and emergency management, including:

- direct reimbursement for any per-transit security and/or emergency management costs (for example, overtime for police or fire department personnel);
- capital costs associated with security/emergency management equipment and personnel base (for example, patrol boats, fire fighting equipment); and
- annual costs for providing specialized training for local fire departments, mutual aid departments, and emergency response personnel; and for conducting exercises.

The cost-sharing plan must include the LNG terminal operator's letter of commitment with agency acknowledgement for each Commonwealth and local agency designated to receive resources.

4.11.9 Conclusions on Reliability and Safety

The principal hazards associated with the substances involved in the storage and vaporization of LNG result from cryogenic and flashing liquid releases; flammable vapor dispersion; vapor cloud ignition; and pool fires. As part of the NEPA review, Commission staff must assess whether the proposed Offshore GasPort would be able to operate safely and securely and minimize potential public safety impacts. Based on our technical review of the preliminary engineering designs, as well as our suggested mitigation measures, we conclude that sufficient layers of safeguards would be included in the facility designs to mitigate the potential for an incident that could impact the safety of the public. The FEED and specifications submitted for the proposed Offshore GasPort to date are preliminary, but would serve as the basis for any detailed design to follow. If authorization is granted by the Commission, the next phase of the Project would include development of the final design. We do not expect that the detailed design information to be developed would result in changes to the basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs which were presented as part of Aguirre LLC's FEED. However, we are recommending that the final design be provided for further staff review to ensure it would be consistent with the safety and operability characteristics identified in the FEED. In addition, we are recommending that the facility, during construction and operation, be subject to regular FERC staff technical reviews and site inspections on at least an annual basis or at other intervals as determined by the Director of OEP. Siting of the facility with regard to potential consequences from these hazards is also required. The FERC authorizes the siting and construction of the proposed Project and the USCG has authority over the management of vessel traffic in and around the LNG facility (as stipulated in 33 CFR 127).

Since 1959, ships have transported LNG without a major release of cargo or a major accident involving an LNG vessel. For the past 50 years, LNG shipping operations have been safely conducted in U.S. ports and waterways. All LNG vessels entering U.S. waters are required to be certified by the USCG as designed and operating in accordance with both international standards and the U.S. regulations for bulk LNG carriers under 46 CFR 154. According to Aguirre LLC, the FSRU proposed for this Project has already been issued a COC.

All LNG vessels used to deliver LNG to the proposed Project as well as the FSRU would have double-hull construction, with the inner and outer hulls separated by about 10 feet. Furthermore, the cargo tanks are normally separated from the inner hull by a layer of insulation approximately 1-foot thick. As a result, the possibility of an LNG release due to an accident, such as a collision or grounding, is considered minimal. Threats and potential credible event scenarios for LNG marine transportation with marine safety, law enforcement, and intelligence agencies were also assessed. The evaluations considered a wide range of possible intentional events such as attacks with shoulder-fired weapons, explosives, and attacks by small to medium size boats and aircraft that could results in spill from the LNG carriers or FSRU. Security procedures could be used to reduce the potential of an LNG spill from intentional causes. Under 33 CFR 105 Aguirre LLC would submit a Facility Security Plan to the USCG for review and approval before commencement of operations. The Facility Security Plan would specify measures that have the capability to continuously monitor the facility's security through a combination of lighting, security guards, waterborne patrols, automatic intrusion-detection devices, or surveillance equipment.

If an LNG spill were to occur along the waterway, the primary hazard to the public would be from radiant heat from a pool fire. In order to assess the maritime safety and security risks of LNG marine traffic travelling to the proposed facility, hazard distances from both accidental and intentional events were estimated for the FSRU and LNG carriers with cargo capacities up to 265,000 m^3. Based on the results of this analysis, the USCG recommended that the waterway along the proposed carrier transit route would be suitable for the type and frequency of LNG marine traffic associated with this proposed Project. However, the USCG's conclusion is contingent upon implementation of the recommended measures, outlined in the LOR Analysis, to responsibly manage the maritime safety and security risks. If the Project is approved and the appropriate resources were not put into place, then neither the FERC nor the USCG would allow the Project to commence service.

4.11.10 Subsea Pipeline

4.11.10.1 Safety Standards

The DOT is mandated to provide pipeline safety under 49 USC Chapter 601. The PHMSA, Office of Pipeline Safety administers the national regulatory program to ensure the safe transportation of natural gas and other hazardous materials by pipeline. It develops regulations and other approaches to risk management that ensure safety in the design, construction, testing, operation, maintenance, and emergency response of pipeline facilities. Many of the regulations are written as performance standards that set a level of safety to be attained and allow the pipeline operator to use various technologies to achieve the required safety standard.

The DOT pipeline standards are published in 49 CFR 190–199. Part 192 specifically addresses natural gas pipeline safety issues. Under a *Memorandum on Natural Gas Transportation Facilities* dated January 15, 1993 between the DOT and the FERC, the DOT is recognized as having the exclusive authority to promulgate federal safety standards used in the transportation of natural gas. Section 157.14(a) (9) (vi) of the FERC's regulations requires that an applicant certify that it will design, install, inspect, test, construct, operate, replace, and maintain the facility for which a Certificate is requested in accordance with federal safety standards and plans for maintenance and inspection, or certify that it has been granted a waiver of the requirements of the safety standards by the DOT in accordance with Section 3(e) of the Natural Gas Pipeline Safety Act. The FERC accepts this certification and does not impose additional safety standards other than the DOT standards. If the Commission becomes aware of an existing or potential safety problem, there is a provision in the *Memorandum on Natural Gas Transportation Facilities* to promptly alert the DOT. The *Memorandum on Natural Gas Transportation Facilities* provides instructions for referring complaints and inquiries made by state and local governments and the general public involving safety matters related to pipelines under the Commission's jurisdiction.

The FERC also participates as a member of the DOT's Technical Pipeline Safety Standards Committee, which determines if proposed safety regulations are reasonable, feasible, and practicable.

Section 5(a) of the Natural Gas Pipeline Safety Act provides for a state agency to assume all aspects of the safety program for intrastate facilities by adopting and enforcing the federal standards, while section 5(b) permits a state agency that does not qualify under section 5(a) to perform certain inspection and monitoring functions. A state may also act as DOT's agent to inspect interstate facilities within its boundaries; however, the DOT is responsible for enforcement actions. Through certification by Office of Pipeline Safety, the Commonwealth inspects and enforces the pipeline safety regulations for intrastate gas pipeline operators in Puerto Rico. This work is performed by the Puerto Rico Public Service Commission.

The Pipeline Safety, Regulatory Certainty and Job Creation Act of 2011 (U.S. House of Representatives 2845) was passed by Congress and signed into law on January 3, 2012 by President Barack Obama. Among other things, this Act states that no later than 2 years after the date of enactment, after considering factors specified in the Act, the DOT Secretary, if appropriate, shall require by regulation the use of automatic or remote control shut-off valves, or equivalent technology, where economically, technically, and operationally feasible on transmission pipeline facilities constructed or entirely replaced after the date on which the Secretary issues the final rule containing such requirement. However, these regulations have not yet gone into effect and would apply to pipelines built in the future.

The Project's pipeline facilities would be designed, constructed, operated, and maintained in accordance with or to exceed the DOT Minimum Federal Safety Standards in 49 CFR 192. These regulations, which are intended to protect the public and to prevent natural gas facility accidents and failures, include specifications for material selection and qualification; minimum design requirements; and protection of pipelines from internal, external, and atmospheric corrosion. As discussed in section 1.2.5, PHMSA's Office of Pipeline Safety has been working with Aguirre LLC to ensure that its proposed construction method meets the requirements of 49 CFR 192.

The DOT defines area classifications, based on population density in the vicinity of a pipeline, and specifies more rigorous safety requirements for populated areas. Pipe wall thickness and pipeline design pressures, hydrostatic test pressures, MAOP, inspection and testing of welds, and frequency of pipeline patrols and leak surveys must conform to higher standards in more populated areas. The class location unit is an area that extends 220 yards (201 m) on either side of the centerline of any continuous 1.0-mile (1.6 km) length of pipeline. The four area classifications are defined below:

- Class 1: Location with 10 or fewer buildings intended for human occupancy;
- Class 2: Location with more than 10 but less than 46 buildings intended for human occupancy;
- Class 3: Location with 46 or more buildings intended for human occupancy or where the pipeline lies within 100 yards (91 m) of any building, or small well-defined outside area occupied by 20 or more people on at least 5 days a week for 10 weeks in any 12-month period; and
- Class 4: Location where buildings with four or more stories aboveground are prevalent.

In accordance with federal standards, class locations representing more populated areas require higher safety factors in pipeline design, testing, and operation.

There are no buildings meant for occupancy within 660 feet (201 m) of the proposed subsea pipeline. Buildings intended for occupancy are located at the northern end of the pipeline near the proposed landfall at Aguirre Plant. There are less than 10 residencies within the class location unit of the pipeline; therefore, the entire pipeline would be classified as Class 1.

If the Project is approved, the DOT regulations require that the pipeline be designed, at a minimum, to the appropriate class location standard. If a subsequent increase in population density adjacent to the right-of-way indicates a change in class location for the pipeline, Aguirre LLC would reduce the MAOP or replace the segment with pipe of sufficient grade and wall thickness, if required, to comply with the DOT code of regulations for the new class location.

The Pipeline Safety Improvement Act of 2002 requires operators to develop and follow a written integrity management program (Part 192, Subpart O) that contains all the elements described in 49 CFR 192.911 and addresses the risks on each transmission pipeline segment. Specifically, the law requires pipeline operators to establish an integrity management program that applies to all high consequence areas and meets Part 192, Subpart O.49 CFR 192 prescribes the minimum standards for operating and maintaining pipeline facilities including the requirement to establish a written plan governing these activities. Under 49 CFR 192.615, each pipeline operator must also establish an emergency plan that includes procedures to minimize the hazards in a natural gas pipeline emergency. Key elements of the plan include procedures for:

- receiving, identifying, and classifying emergency events, gas leakage, fires, explosions, and natural disasters;
- establishing and maintaining communications with local fire, police, and public officials and coordinating emergency response;
- initiating the emergency shutdown of system and safe restoration of service;
- making personnel, equipment, tools, and materials available at the scene of an emergency;
- protecting people first and then property and making them safe from actual or potential hazards.
- notifying appropriate fire, police, and other public officials of gas pipeline emergencies and coordinating with them both planned responses and actual responses during an emergency; and
- restoring any service outage safely.

In addition, 49 CFR 192 requires that each operator establish and maintain liaison with appropriate fire, police, and public officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency and to coordinate mutual assistance. The operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to appropriate public officials.

An Emergency Plan as required by 49 CFR 192 for the pipeline component of the Project will be incorporated into the overall Emergency Response Plan for the Project (see section 4.11.2).

4.11.11 Pipeline Accident Data

The DOT requires all operators of natural gas transmission pipelines to notify the DOT of any significant incidents and to submit a report within 20 days. Significant incidents are defined as any leaks that:

- cause a death or personal injury requiring hospitalization; or
- involve property damage of more than $110,000.[16]

During the 20-year period from 1992 through 2011, a total of 1,197 significant incidents were reported on the more than 300,000 total miles (482,800 km) of natural gas transmission pipelines nationwide.

Additional insight into the nature of service incidents may be found by examining the primary factors that caused the failures. Table 4.11.11-1 provides a distribution of the causal factors as well as the number of each incident by cause. The dominant incident causes (corrosion; and pipeline material, weld, or equipment failure) comprise 47 percent of all significant incidents. The pipelines included in the data set in table 4.11.11-1 vary widely in terms of age, pipe diameter, and level of corrosion control. Each of these variables influences the incident frequency that may be expected for a specific segment of pipeline. The frequency of significant incidents, for example, is strongly dependent on pipeline age. Older pipelines have a higher frequency of corrosion incidents because corrosion is a time-dependent process.

The use of both an external protective coating and a cathodic protection system, required on all pipelines installed after July 1971, significantly reduces the corrosion rate compared to unprotected or partially protected pipe.[17]

TABLE 4.11.11-1

Natural Gas Transmission Pipeline Significant Incidents by Cause (1993 to 2012)[a]

Cause	Number of Incidents	Percentage[a]
Corrosion	286	23.6
Excavation[b]	203	16.8
Pipeline material, weld, or equipment failure	285	23.5
Natural force damage	144	11.9
Outside forces[c]	67	5.5
Incorrect operation	32	2.6
All other causes[d]	194	16.0
Total	**1,211**	–

Source: PHMSA, 2014.
[a] Due to rounding, column does not total 100 percent.
[b] Includes third-party damage.
[c] Fire, explosion, vehicle damage, previous damage, intentional damage.
[d] Miscellaneous causes or unknown causes.

Excavations, natural forces, and outside forces are the causes in 34 percent of significant pipeline incidents. Table 4.11.11-2 presents information on these incidents by cause. The incidents mostly result from the encroachment of mechanical equipment such as bulldozers and backhoes; earth movements due

[16] As of December 2012, 110,000 dollars is approximately 50,000 in 1984 dollars (CPI, Bureau of Labor Statistics, ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt, January 16, 2013).

[17] Cathodic protection is a technique to reduce corrosion (rust) of the natural gas pipeline that includes the use of an induced current or a sacrificial anode (like zinc) that corrodes at faster rate to reduce corrosion.

to soil settlement, washouts, or geologic hazards; and weather effects such as winds, storms, and thermal strains.

TABLE 4.11.11-2

Outside Forces Incidents by Cause (1993 to 2012) [a]

Cause	Number of Incidents	Percent of all Incidents [b]
Third-party excavation damage	170	14.0
Operator excavation damage	25	2.0
Unspecified equipment damage/previous damage	4	0.3
Previous damage due to excavation	4	0.3
Heavy rain/floods	70	5.7
Earth movement	38	3.1
Lightning/temperature/high winds	21	1.6
Other/unspecified natural force	15	1.1
Vehicle (not engaged with excavation)	42	3.4
Fire/explosion	8	0.6
Previous mechanical damage	5	0.4
Intentional damage	1	0.0
Other/unspecified outside force	5	0.3
Maritime equipment or vessel adrift/ maritime activity	6	0.4
Total	**414**	**--**

[a] Excavation, outside forces, and natural force damage from table 4.11.11-1.
[b] Due to rounding, column does not equal 34.2 percent.

Older pipelines have a higher frequency of outside forces incidents partly because their location may be less well known and less well marked than newer lines. In addition, the older pipeline systems contain a disproportionate number of smaller diameter pipelines, which have a greater rate of outside forces incidents. Small diameter pipelines are more easily crushed or broken by mechanical equipment or earth movements.

4.11.11.1 Impact on Public Safety

Table 4.11.11-3 presents the average annual injuries and fatalities that occurred on natural gas transmission lines between 2008 and 2012. The data have been separated into employees and nonemployees, to better identify a fatality rate experienced by the general public. Fatalities among the public averaged two per year over the 20-year period from 1993-2012 (PHMSA, 2014).

TABLE 4.11.11-3

Annual Average Fatalities – Natural Gas Transmission Pipelines

	Injuries		Fatalities	
Year	Employees	Public	Employees	Public
2008	3	2	0	0
2009	4	7	0	0
2010 [a]	10	51	2	8
2011	1	0	0	0
2012	3	4	0	0

[a] All of the public injuries and fatalities in 2010 were due to the Pacific Gas and Electric pipeline rupture and fire in San Bruno, California on September 9, 2010.

The majority of fatalities from pipelines involve local distribution pipelines. These are natural gas pipelines that are not regulated by the FERC and that distribute natural gas to homes and businesses after transportation through interstate natural gas transmission pipelines. In general, these distribution lines are smaller diameter pipes, often made of plastic or cast iron rather than welded steel, and tend to be older pipelines that are more susceptible to damage. In addition, distribution systems do not have large rights-of-way and pipeline markers common to the FERC-regulated natural gas transmission pipelines.

The nationwide totals of accidental fatalities from various manmade and natural hazards are listed in table 4.11.11-4 to provide a relative measure of the industry-wide safety of natural gas transmission pipelines. Direct comparisons between the different accident categories listed in the table should be made cautiously because individual exposures to hazards are not uniform among all categories. The data nonetheless indicate a low risk of death due to incidents involving natural gas transmission pipelines compared to the other categories. For example, the fatality rate for incidents involving natural gas pipelines is more than 25 times lower than the rate from natural hazards such as lightning, tornados, floods, and earthquakes.

TABLE 4.11.11-4

Nationwide Accidental Deaths [a]

Type of Accident	Annual Number of Deaths
All accidents	117,809
Motor Vehicle	45,343
Poisoning	23,618
Falls	19,656
Injury at work	5,113
Drowning	3,582
Fire, smoke inhalation, burns	3,197
Floods [b]	93
Lightning [b]	57
Tornado [b]	57
Natural gas distribution lines [c]	14
Natural gas transmission pipelines [c]	2

a U.S. Census Bureau, 2010b.
b National Weather Service, 2012.
c PHMSA, 2014.

The available data show that natural gas transmission pipelines continue to be a safe, reliable means of energy transportation. From 1993 to 2012, there were an average of 61 significant incidents and two fatalities per year (PHMSA, 2014). The number of significant incidents over the more than 300,000 miles (482,800 km) of natural gas transmission lines indicates the risk is low for an incident at any given location. The operation of the Project would represent a slight increase in risk to the nearby public.

4.12 CUMULATIVE AND OTHER IMPACTS

Cumulative impacts may result from the incremental effects associated with an action when added to temporary or permanent impacts associated with past, present, and reasonably foreseeable future actions. The cumulative effects of multiple projects may be significant even if each individual action is not. The synergistic impacts from all actions could be significant if mitigative or other measures are not implemented.

The affected environment considered in the analysis of cumulative impacts associated with this Project includes the Offshore GasPort, the subsea pipeline, and onshore facilities. Onshore components of the Project include temporary construction work areas and permanent facilities needed for operation of the proposed Project that are non-jurisdictional (see section 1.4). Because the impacts of the onshore components are temporary and involve minimal land disturbance, the analysis of cumulative impacts associated with the Project focus primarily on offshore components.

The Comité Diálogo Ambiental filed comments expressing concerns that approval of the Project could lead to exacerbation of several sensitive and degraded resources in the vicinity of the Project. Impacts from the Project could cumulatively contribute to loss of marine habitat, decreased water quality, loss of traditional fishing activities, and degradation of air quality. The commentor also noted that these resources are already affected by several nearby operating facilities including municipal landfills, a coal burning power plant, and a scrap metal operation. Several abandoned facilities were noted as well and include a sugar mill with deteriorating buildings, a former petrochemical facility, and a former tire recycling operation. Further, nearby residential housing development is noted as contributing to the loss of groundwater quality and quantity and prime agricultural lands (Comité Diálogo Ambiental, 2013). As noted above, the focus of the cumulative impacts analysis is primarily on Project facilities located offshore. The cumulative impacts on the resources identified in the Comité Diálogo Ambiental letter are discussed below, where applicable.

4.12.1 Past, Present, and Reasonably Foreseeable Cumulative Actions

Actions considered in this analysis vary from the Project in duration and scale and those that have been, are in the process of, or are likely to be completed are evaluated. The actions considered are illustrated on figure 4.12.1-1 and discussed below.

Existing Facilities/Under Construction and Completed Activities

<u>AES Ilumina Solar Photovoltaic Power Plant</u>

AES Ilumina constructed a 24-MW photovoltaic power plant on a 138-acre (142 cuerdas) site in Guayama, approximately 4.5 miles (7.2 km) east of the Aguirre Plant. The project was completed in October 2012 and is the first utility scale solar energy project in Puerto Rico. Electricity generated at the facility is sold to PREPA under a 20-year power purchase agreement. Energy generated at the facility is capable of meeting the needs of 6,500 area households (AES Solar, 2011).

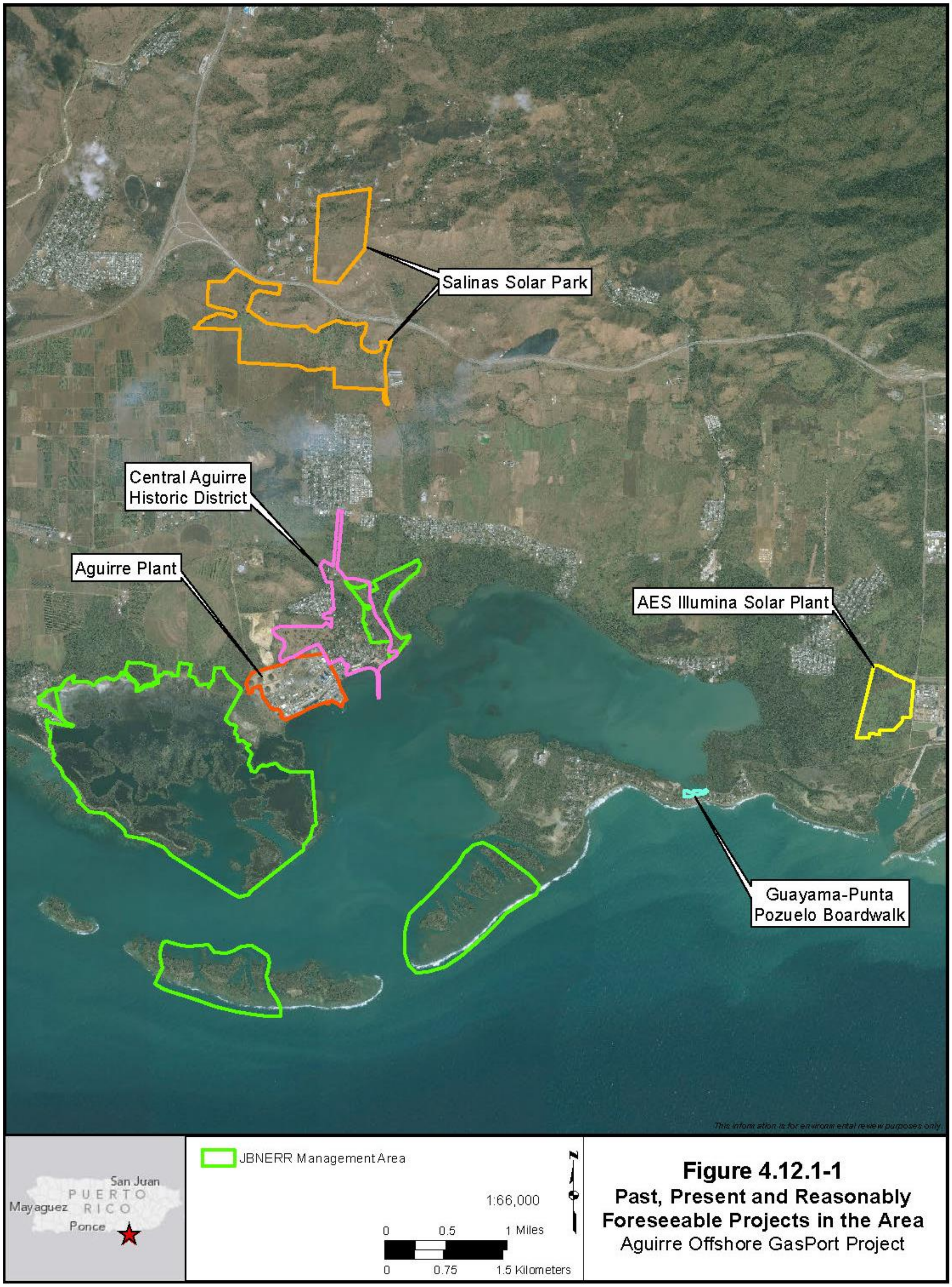


Figure 4.12.1-1
Past, Present and Reasonably Foreseeable Projects in the Area
Aguirre Offshore GasPort Project

Salinas Solar Park

Partner companies Sonnedix and Yarotek began construction in November 2012 of the first of two phases of the Salinas Solar Park, a 16-MW photovoltaic power plant on a 140-acre (144 cuerdas) site in Salinas, 2.5 miles (4.0 km) north of the Aguirre Plant. The Salinas Solar Park will provide services to approximately 2,500 households (Sonnedix, 2013).

Guayama-Punta Pozuelo Boardwalk

The municipality of Guayama is constructing a boardwalk along State Road PR-7710 in Barrio Punta Pozuelo, approximately 3 miles (4.8 km) southeast of the Aguirre Plant and 3.5 miles (5.6 km) northeast of the Offshore GasPort. The boardwalk project has a northerly view of Jobos Bay and includes park areas, gazebos, small areas for commercial use, facilities for kayak use, parking lots, and an observation point/monument site. Status of the project is not known, but based on recent aerial photography the project appears to be close to completion. Direct impact on Jobos Bay is limited to a small beach access point (Desarrollo Integral Del Sur, Inc., undated).

Proposed and Reasonably Foreseeable Projects

Aguirre Plant Fuel Conversion

As discussed in section 1.1, the purpose of the proposed Project is to provide LNG storage capacity and sustained deliverability of natural gas directly to the Aguirre Plant, which would facilitate PREPA's conversion of the Aguirre Plant from fuel oil only to dual-fuel generation facility, capable of burning diesel and natural gas for the combined cycle units and fuel oil and natural gas for the thermoelectric plant.

Master Plan for the Renovation of Aguirre

A master plan for the renovation of several existing historic structures throughout the area has been developed by the Polytechnic University of Puerto Rico. The conceptual plan has been reviewed and endorsed by the DNER and the Puerto Rico Tourism Company but has not advanced beyond the conceptual phase. Renovation projects would include redevelopment of urban areas and infrastructure including a small craft marina along the abandoned sugar mill pier. The primary objective of the master plan is to preserve the historic values of Aguirre and develop tourism attractions in the area (American Institute of Architects, 2011).

Management Plan for the JBNERR

The DNER has established a management plan for Jobos Bay that is revised every 5 years (DNER, 2010). The intent of the management plan is to preserve the natural resources of Jobos Bay while promoting its educational and recreational uses in a sustainable manner. The JBNERR has designated areas for education, outreach, passive recreation activities (i.e., picnicking, camping, bird watching, hiking, and recreational water uses), and limited public water access facilities. Many of the improvements in the management plan have been implemented with new projects underway as periodic revisions to the plan are approved. These improvements include upgraded dormitory, security, and office facilities; laboratory relocation and expansion; increased parking facilities; construction of maintenance and storage buildings; construction of a community volunteer office; and interpretive signs for the public.

4.12.2 Cumulative Impact Analysis by Resource Area

Potential impacts most likely to be cumulative with the Project's impacts are related to water resources, air quality, and noise. The Project could contribute to these cumulative impacts; however, our recommendations and Aguirre LLC's proposed mitigation measures would minimize adverse impacts as described in section 5.0. The section below also provides a qualitative analysis of the Project's contribution to climate change.

Because this analysis is focused on the offshore Project facilities, cumulative impacts with the onshore projects listed above on sensitive benthic habitat and marine wildlife are not anticipated. In fact, the operation of the proposed Project would reduce the fuel oil barge traffic in Jobos Bay, thereby reducing the potential for vessel strikes and other impacts on sensitive resources in the bay. Similarly, we do not anticipate any cumulative impacts on soils and geology because the Project's associated impacts would occur at the terminal site and any cumulative soils impacts would be minimized by distance of the Project to the projects listed above.

Due to the majority of the Project occurring offshore, we do not anticipate any cumulative impacts on wetlands or vegetated upland areas in the Project area. As the onshore component, including the conversion of the existing fuel-oil boilers, generators, and turbines would entail the use of temporary construction workspaces and the only permanent onshore facilities would be within currently developed areas within the existing Aguirre Plant, we do not anticipate any impacts on wetlands or any permanent affects vegetated upland areas. As it is uncertain when, if ever, other proposed projects in the area would occur, the Project is not anticipated to have any cumulative impacts on wetlands or vegetated upland areas.

The Central Aguirre Historic District was the only identified cultural resource near the Project. This District is approximately 500 feet (152 m) northeast of the onshore portion of the Project area, and the Project facilities would be within the viewshed of the District. As the onshore facilities would be within the Aguirre Plant boundaries, they would not cause additional negative impacts on the District. In addition, at this time it is uncertain when, if ever, any of the other planned projects within the Project area and near the Central Aguirre Historic District would occur. Therefore, no cumulative impacts are anticipated to cultural resources from onshore Project facilities. The offshore portion of the Project is approximately 3.5 miles (5.6 km) southwest of the Central Aguirre Historic District, and the view is at least partially, if not fully, obstructed by barrier islands. Therefore, due to the distance from the Project area and the obstructed view, the offshore portion of the Project would not contribute to cumulative impacts on cultural resources.

Impacts associated with the Guayama-Punta Pozuelo Boardwalk project, renovation projects in Aguirre, and JBNERR Management Plan would represent beneficial improvements to the human and natural environment. Therefore, cumulative impacts on land use, recreation, visual resources, and socioeconomics are not anticipated.

4.12.2.1 Water Resources

The Aguirre Plant is the only current single point source discharge within Jobos Bay. The facility has obtained a NPDES permit from the EPA allowing discharge to the bay (Whitall, et al., 2011). Power station cooling water discharges through an approximately 0.8-mile-long (1.3 km) pipe to a point at the western edge of the bay just offshore of Punto Colchones. According to the NPDES permit (Permit No. PR0001660), the daily maximum discharge temperature at the outfall is 106 ºF (41 ºC), and reaches the PREQB water quality standard of 90°F (32.2°C) within the defined interim mixing zone (approximately 1,700 feet [518 m] north and south of the outfall). It is presumed that the Aguirre Plant water discharges are within the regulated limits established by the NPDES permit, and there is no plan to alter the current seawater intake or discharge rates. The proposed subsea pipeline would be about 0.6 mile (1.0 km) east of the cooling water discharge at its closest point.

Operation of the FSRU and visiting LNG carriers at the offshore berthing platform would involve water discharges with thermal effects. The thermal plume from water discharged during operation would be limited to the immediate vicinity of the FSRU and LNG carriers (see section 4.3). The Offshore GasPort would be approximately 2.2 miles (3.5 km) from the Aguirre Plant cooling water discharge, located outside of Jobos Bay, and separated from the bay by barrier islands. Because any water temperature impact from operation of the Project would be limited to the vicinity of the offshore facilities outside of Jobos Bay and well removed from the existing power station discharge point, these discharges would not act cumulatively and their thermal plumes would equilibrate with ambient temperatures.

Construction of the Project would primarily affect water quality by causing temporary increases in turbidity from the installation of the Offshore GasPort and subsea pipeline. These impacts would dissipate quickly following construction. Water used for construction of the Project facilities would not contain any additives. During operations, water may be treated with biocides as necessary and in compliance with permits issued for that purpose.

Additional existing sources of water quality impacts within the Project area include sediment disturbance from barges and recreational vessels in shallow waters, the potential for spills from barges and recreational vessel using Jobos Bay, and non-point source runoff from the land surrounding Jobos Bay. The water quality impacts from barges, recreational vessels, and runoff historically has been minimal and infrequent. There are currently no known proposed or past projects that would directly affect water quality within Jobos Bay while occurring during the Project construction period. Therefore, water quality impacts of the proposed Project when considered cumulatively with other projects would not be significant.

4.12.2.2 Air Quality

The AES Ilumina and Salinas Solar Park facilities provide emissions-free energy to electric utility customers in the vicinity of the Project, presumably displacing demand for service from the Aguirre Plant. Although comparatively minor in scale, the operation of these solar facilities would reduce the amount of power output from the Aguirre Plant, potentially decreasing air emissions from the plant. Further, the purpose of the solar facilities is to reduce Puerto Rico’s dependence on oil and to further diversify energy sources for users on the island. Operation of these facilities would contribute to a beneficial impact on air quality.

Construction of the Guayama-Punta Pozuelo Boardwalk may be complete before construction of the Project commences. However, if construction of the Project, the Boardwalk, and the ongoing activities under the JBNERR Management Plan coincide, cumulative air quality impacts could be additive but would be minimal due to the limited, short-term nature of pipeline construction in Jobos Bay. Construction-related air quality impacts would subside once construction activities are complete. Further, construction the Project is expected to be near completion or complete before renovation projects in Aguirre commence and we do not anticipate any cumulative air quality impacts. We did not identify any permanent emission sources associated with the Guayama-Punta Pozuelo Boardwalk, the ongoing activities under the JBNERR Management Plan, or renovation projects in Aguirre, and we do not anticipate any significant cumulative air quality impacts as a result of the Project.

Cumulative impacts on air quality could be affected by the contribution of emissions from construction and operation of the Project when considered with other industrial operations nearby. The

AES coal-fired power plant in Guayama emits NO_x, CO, VOCs, particulate matter, SO_2, sulfuric acid, various metals, and GHGs. Conversion of the Aguirre Plant from fuel oil to natural gas as its primary fuel would change the contribution of emissions from the plant, mostly in beneficial ways. As discussed in section 4.10.1, the existing Aguirre Plant is currently a PSD major source for every regulated NSR pollutant except VOC. The use of natural gas at the Aguirre Plant would result in substantial reductions in particulate matter, SO_2, NO_x, CO, and sulfuric acid mist.

Due to concerns about cumulative impacts, the EPA commented that the Project would consume only 39 percent of the total natural gas capacity that is unloaded into the FSRU, leaving much unused sendout capacity. The EPA inquired if the Offshore GasPort was seeking or would seek different natural gas markets to sell its unused capacity. Excelerate Energy responded, indicating that the Project is appropriately sized. The FSRU must maintain sufficient fuel storage for the Aguirre Plant, and the volume of LNG delivered to the FSRU must be greater than the volume of natural gas to be delivered to the Plant. The LNG to be supplied by the FSRU is fully committed to be used exclusively at the Plant. Further, the EPA asserted in its finding on the PSD Non-applicability analysis for the Aguirre Plant and the Project, that certain permit conditions concerning the FSRU's available capacity be included in the EQB air quality construction permits. Therefore, no excess LNG would be provided to other users or markets and there would be no emissions other than these estimated for the Aguirre Plant.

Aguirre Plant Fuel Conversion

The Aguirre Plant consists of twelve oil-fired electric generation units as follows:

- steam power plant, consisting of two oil-fired steam boilers (AG 1 and 2) with a total generating capacity of 900 MW;
- combined cycle power plant (CC 1 and 2), consisting of eight oil-fired combustion turbines with two steam generators with a total generating capacity of 600 MW; and
- power block, consisting of two simple cycle oil-fired combustion turbines with a total generating capacity of 40 MW.

The two boilers are each rated at 4,180 MMBtu/hour and the combined cycle units are rated at 607.5 MMBtu/hour each. The two simple cycle power block combustion turbines are rated at 301.5 MMBtu/hour each. Total Aguirre Plant electrical output is rated at 1,540 MW. All Plant generating units are subject to conditions in (CAA) Title V Operating Permit No. PFE-TV-4911-63-0796-0005 issued on February 24, 2008. Only the steam boilers at the steam plant (AG 1 and 2) and the eight combustion turbines at the combined cycle power plant (CC 1 and 2) are proposed to be converted to use natural gas as part of the Aguirre Plant/Offshore GasPort Conversion Project.

Air Quality Regulations

Refer to section 4.10.1.2 for a description of the federal and local air quality regulations applicable to the Project.

Prevention of Significant Deterioration

PSD regulations are intended to preserve the existing air quality in attainment areas where pollutant levels are below the NAAQS. In addition to requiring an extensive review of environmental impacts, viable emissions-control technologies, and related impacts, PSD regulations impose specific limits on the amount of pollutants that major new or modified stationary sources might contribute to existing air quality levels.

PREPA has filed a PSD Non-Applicability Application with the EPA. A courtesy copy has been presented to the EQB to incorporate PSD conditions issued by EPA Region 2. In its application, PREPA asserts that the proposed Project be considered part of the Aguirre Plant because the Offshore GasPort would be constructed to store and supply natural gas to the Aguirre Plant. As mentioned previously, the EPA determined that the PSD requirements would not be applicable to the Aguirre Plant/Offshore GasPort. In essence, the cumulative operational air quality impacts associated with the Aguirre Plant and the proposed Project would be evaluated by the EQB and EPA in processing the applicable air quality permits.

For 28 specific source categories, the PSD major source threshold is 100 tpy (91 mtpy). Because fossil fuel boilers with a heat input capacity greater than 250 MMBtu/hour are one of the 28 listed source categories, the Aguirre Plant/Offshore GasPort is subject to the 100-tpy (91 mtpy) major source threshold. The existing Aguirre Plant is a major source of air pollutants, and is located in an area that is designated as “attaining” the NAAQS for all criteria pollutants.

Physical changes and/or changes in the method of operation trigger a review of past (baseline) and projected future actual or potential air pollutant emissions to determine if PSD review would apply. Conversion of the boilers and combined cycle units at the Plant to use natural gas would require the installation of new burners and controls in the boilers and turbines, construction of the Offshore GasPort, and new piping to transport the natural gas from the Offshore GasPort to the Plant. This would represent a physical change. Furthermore, use of natural gas would be a change in the method of operation of these units. Once the conversion project is completed, the boilers (AG 1 and 2) would have the capacity to generate electricity in various dual firing (No. 6 oil, Bunker C, and natural gas) scenarios. In the case of the combined cycle units, the gas turbines would have the capacity to generate electricity by firing either No. 2 fuel oil or natural gas.

PREPA plans to accept enforceable operational limits on the boilers and the combined cycle units at the Plant, thus rendering PSD review inapplicable. PREPA plans to limit future AG 1 and 2 operations to a 55 percent annual capacity factor and the combined cycle units to a 35 percent annual capacity factor.

For the Aguirre Plant/Offshore GasPort, PSD applicability was determined based on a proposed increase above actual emissions. In assessing PSD applicability, PREPA used the following procedure (AECOM, 2013):

- Calculate baseline actual emissions (40 CFR 52.21 (b)(48)) for the boilers and combined cycle combustion turbines based on the average rate in tpy that the units emitted during a consecutive 24-month period during the 5 years immediately preceding the date that construction is commenced. Note that a different 24-month period can be selected for each PSD-regulated pollutant.

- Calculate the future potential emissions for the boilers and the combined cycle combustion turbines based on the anticipated future power production by the units. Since the Project is also part of the Aguirre Plant/Offshore GasPort, the potential emissions from the Offshore GasPort are also accounted for in the applicability analysis.

- Calculate contemporaneous emission changes associated with minor source permits (there were no contemporaneous emission changes for the Project and none are expected by the end of the contemporaneous period).

- Subtract baseline actual emissions from future potential emissions (including potential emissions from the Offshore GasPort) to determine the “emissions change” due to the Project. If the difference is less than the PSD significant emission rate for each PSD pollutant, the Project is considered a “minor modification” and PSD review does not apply. If the difference is greater than the PSD significance threshold for at least one pollutant, the Project is considered a “major modification” and PSD review applies for that pollutant.

The emissions increases for each pollutant are presented in table 4.12.2-1 below. Therefore, based on these emissions data, the Aguirre Plant/Offshore GasPort would be considered a minor modification according to the PSD regulations because the change in emissions of all PSD-regulated pollutants (Step 1 of the applicability test) is below EPA’s significant emission rates, as defined in 40 CFR 52.21(b)(23)(i) (AECOM, 2013).

TABLE 4.12.2-1

Net Emissions Changes and Significance for the Aguirre Plant and Aguirre Offshore Gasport Project

Pollutant	Baseline Actual Emission (tpy [mtpy])	CC 1 & 2 Emisions Change (tpy [mtpy])	AG 1 & 2 Emisions Change (tpy [mtpy])	GasPort Potential Emissions (tpy [mtpy])	Emissions Increase (tpy [mtpy])	PSD “Significant” Threshold (tpy [mtpy])	PSD Applicability (Yes/No)
NO_x	7,514 (6,817)	-335 (-304)	-569 (-516)	110 (100)	-795 (-721)	40 (36)	No
CO	1,415 (1,284)	175 (159)	-590 (-535)	123 (112)	-293 (-266)	100 (91)	No
VOC	25 (23)	9 (8)	8 (7)	16 (15)	32 (29)	40 (36)	No
PM	1,205 (1,093)	-8 (-7)	-298 (-270)	21 (19)	-285 (-259)	25 (23)	No
PM_{10}	1,298 (1,178)	5 (5)	-353 (-320)	21 (19)	-327 (-297)	15 (14)	No
$PM_{2.5}$	876 (795)	5 (5)	-202 (-183)	21 (19)	-175 (-159)	10 (9)	No
SO_2	11,259 (10,214)	-176 (-160)	-5,660 (-5,135)	21 (19)	-5,815 (-5,275)	40 (36)	No
H_2SO_4	503 (456)	-9 (-8)	-251 (-228)	1 (1)	-259 (-235)	7 (6)	No
Lead	0.2 (0.2)	0.0	-0.1 (-0.1)	0.0	-0.1 (-0.1)	0.6 (0.6)	No
Fluoride	3 (3)	0	0	0	0	3 (3)	No
GHG (total mass)	4,113,379 (3,731,595)	646,935 (586,890)	-925,977 (-840,050)	321,266 (291,448)	42,204 (38,287)	N/A	N/A
GHG (CO_2e)	4,131,111 (3,747,681)	647,042 (586,987)	-931,876 (-845,384)	321,825 (291,955)	-36,991 (33,558)	75,000 (68,039)	No

Through compliance with federal permitting requirements and federally enforceable emissions limits, emissions contributions in aggregate with other nearby emission sources would constitute a minor cumulative impact. When considered in the context of increased power demand and availability from all available sources, conversion of the Aguirre Plant resulting from the Project would limit the overall cumulative impact on local and regional air quality.

Air Quality Impact Assessment

Modeling Methodology

Aguirre LLC conducted a cumulative air quality dispersion model impact analysis with the OCD model to assess the air quality concentrations for all criteria pollutants. This analysis was conducted for the proposed Offshore GasPort and the onshore Aguirre Plant. The analysis includes evaluation of the Offshore GasPort stationary emission sources (FSRU sources, platform sources, and LNG carrier unloading) as well as the LNG carrier hoteling emissions and the transitory (mobile) emission sources operating within the safety zone (tug boats, other support vessels, and the LNG carriers moving to and from the Offshore GasPort platform within the safety zone). The OCD model is the model recommended by the EPA for sources located over water and it uses meteorological data from both over-land and over-water weather stations. The OCD model can also account for the overwater transport and dispersion and shoreline effects (i.e., development of the thermal internal boundary layer, sea breeze, and fumigation).

The Aguirre Plant sources considered consist of the two steam boilers and the eight combined cycle turbines while operating on natural gas provided from the GasPort. The Plant's two simple cycle turbines were not considered since they are not expected to operate while the Offshore GasPort is providing natural gas to the Plant. Tables 4.12.2-2 and 4.12.2-3 provide the emissions and stack/exhaust parameter data for the Offshore GasPort and Aguirre Plant sources, respectively. Building dimensions (height and maximum projected width) for the power plant structures associated with each stack were also input to the OCD model.

The OCD model was used to predict maximum pollutant concentrations in ambient air from the Project emissions for comparison with the NAAQS. The OCD model was applied to the Offshore GasPort modeling using all the regulatory default options including use of: stack-tip downwash, buoyancy-induced dispersion, calms processing routines, upper-bound downwash concentrations for super-squat buildings, default wind speed profile exponents, vertical potential temperature gradients, and no use of gradual plume rise. As recommended by the EPA, the model was used with rural dispersion coefficients and included the effects of local terrain into the calculations. The grid extent encompasses an area of 12 miles (20 km) from the center point. Most of this receptor grid is over water and has ground elevation of 0 meters.

Meteorological Data for Offshore and Coastal Dispersion Modeling

The OCD model uses hourly over-land and over-water meteorological data to simulate the plume transport and dispersion for shoreline conditions. Data from land-based monitoring stations and water-based buoy monitoring stations representative of site conditions were input to the OCD model. Hourly surface meteorological data for the year 2011 were obtained for the nearby Jobos Bay Reserve (JOXP4), Puerto Rico meteorological monitoring station operated by JBNERR. This station is approximately 3.6 miles (5.8 km) from the Project site and is representative of the shoreline immediately adjacent to the Project. Missing data were filled with second and third level data sources from Mercedita Airport in Ponce (TJPS), and Magueyes Islands, (MGIP4), both of which are also located on the southern coastal area of Puerto Rico. The primary source of data for cloud cover data is Mercedita Airport (23.1 miles [37.2 km) from Project site) with missing data filled from Roosevelt Roads Naval Station (TJNR) in Ceiba and Luis Muñoz Marin International Airport (TJSJ) in San Juan. The surface data were processed with concurrent mixing height data from TJSJ to create the over-land meteorological file required by the OCD model.

Hourly over-water meteorological data concurrent with the 2011 over-land meteorological data were also used in the modeling analysis. The primary source for hourly over-water meteorological data was NOAA's National Data Buoy Center for Buoy Station 42085. This buoy is approximately 19.6 miles (31.5 km) west-southwest of the proposed Project location. Missing data were filled with second and third level data sources from Eastern Caribbean and Central Caribbean Buoy Stations 42059 and 42058, respectively. Concurrent mixing height data from the TJSJ station were also used for the over-water data set. Additional receptors were placed along the western edge of the neighborhood located just to the east of the Aguirre Plant, and along southern edge of the neighborhood north of the Plant. These additional receptors ensured that maximum impact concentrations were not overlooked at these sensitive areas.

TABLE 4.12.2-2

Offshore and Coastal Dispersion Model Emissions and Exhaust Parameters for Offshore GasPort Modeled Sources for the Aguirre Offshore GasPort Project

Source Description	NO_x (lb/hr [g/s])	CO (lb/hr [g/s])	PM_{10} / $PM_{2.5}$ (lb/hr [g/s])	SO_2 (lb/hr [g/s])	Stack Height (ft [m])	Stack Temp (K)	Stack Dia-meter (ft [m])	Exit Velocity (ft/s [m/s])	Stack Angle (D_{eg})	Grd-level Elev (ft [m])
Boiler 1 [a]	4.3 (0.54)	5.0 (0.63)	1.7 (0.21)	1.6 (0.2)	122.7 (37.4)	352 (451)	4.6 (1.4)	69.6 (21.2)	45	0.0
Boiler 2 [a]	4.3 (0.54)	5.0 (0.63)	1.7 (0.21)	1.6 (0.2)	122.7 (37.4)	352 (451)	4.6 (1.4)	69.6 (21.2)	45	0.0
Auxiliary Boiler [b]	2.9 (0.37)	7.1 (0.89)	1.2 (0.15)	0.1 (0.012)	122.7 (37.4)	392 (473)	4.6 (1.4)	68.2 (20.8)	45	0.0
DFDE Generator [c]	11.5 (1.45)	29.3 (3.69)	0.2 (0.03)	0.2 (0.03)	122.7 (37.4)	626 (603)	2.3 (0.7)	93.8 (28.6)	45	0.0
Platform Engine Gas 1 [d]	1.0 (0.13)	2.1 (0.26)	0.0 (0.0043)	0.0 (0.00034)	20.0 (6.1)	892 (751)	0.7 (0.2)	122.0 (37.2)	0	52.5 (16.0)
Platform Engine Gas 2 [d]	1.0 (0.13)	2.1 (0.26)	0.0 (0.0043)	0.0 (0.00034)	20.0 (6.1)	892 (751)	0.7 (0.2)	122.0 (37.2)	0	52.5 (16.0)
Platform Engine Oil 1 [d]	0.2 (0.0264)	0.2 (0.0198)	0.0 (0.0013)	0.0 (0.00047)	20.0 (6.1)	899 (755)	0.7 (0.2)	91.2 (27.8)	0	52.5 (16.0)
LNG Carrier Steam Turbine Unloading + Hoteling [e]	N/A	N/A	N/A	17.1 (2.16)	122.7 (37.4)	320 (433)	4.6 (1.4)	15.1 (4.6)	45	0.0
LNG Carrier Steam Turbine Safety Zone + Idling [f]	N/A	N/A	N/A	1.3 (0.16)	122.7 (37.4)	311 (428)	4.6 (1.4)	8.2 (2.5)	45	0.0
LNG Carrier Medium-speed Dual-fuel Diesel (MSD) Unloading + Hoteling [g]	121.7 (15.33)	46.0 (5.8)	1.9 (0.24)	N/A	122.7 (37.4)	682 (634)	4.6 (1.4)	35.1 (10.7)	45	0.0
LNG Carrier MSD Safety Zone + Idling [h]	11.0 (1.38)	4.1 (0.52)	0.2 (0.02)	N/A	122.7 (37.4)	682 (634)	4.6 (1.4)	23.0 (7.0)	45	0.0
Support Vessel + Tugs (20 percent of total mass emissions) [i]	6.2 (0.78)	1.7 (0.21)	0.2 (0.025)	0.1 (0.012)	19.7 (6.0)	590 (583)	2.3 (0.7)	65.6 (20.0)	45	0.0
Support Vessel + Tugs (40 percent of total mass emissions) [i]	12.5 (1.57)	3.3 (0.42)	0.4 (0.049)	0.2 (0.024)	19.7 (6.0)	590 (583)	2.3 (0.7)	65.6 (20.0)	45	0.0
Support Vessel + Tugs (40 percent of total mass emissions) [i]	12.5 (1.57)	3.3 (0.42)	0.4 (0.049)	0.2 (0.024)	19.7 (6.0)	590 (583)	2.3 (0.7)	65.6 (20.0)	45	0.0

[a] Boilers 1 and 2 emissions are average annualized emission rates based on 7,833 hours on boil-off gas, 696 hours on heavy fuel oil, 183 hours of burner lightings, and 48 hours of start-up.

[b] Auxiliary boiler emissions are average annualized emission rates based on 8,724 hours on boil-off gas and 36 hours of start-up.

[c] DFDE generator emissions are based on maximum hourly emissions under normal dual fuel operation.

[d] Platform engine emissions are based on maximum hourly emissions.

[e] LNG Carrier steam turbine unloading and hoteling emissions are based on maximum hourly emissions of the steam turbine propulsion LNG carriers at berth (higher than MSD emissions for SO_2).

[f] LNG Carrier steam turbine safety zone and idling emissions are based on annual average emissions for operation of the steam turbine propulsion LNG carriers within the safety zone (higher than MSD emissions for SO_2).

[g] LNG Carrier MSD unloading and hoteling emissions are based on maximum hourly emissions of the medium speed diesel propulsion LNG carriers at berth (higher than steam turbine emissions for NO_x, CO, and PM).

[h] LNG Carrier MSD safety zone and idling emissions are based on annual average emissions for operation of the medium speed diesel propulsion LNG carriers within the safety zone (higher than steam turbine emissions for NO_x, CO, and PM).

[i] Support Vessel and Four Tug emissions assume three locations along the platform, one location for the support vessel, and two locations with two co-located tugs each.

TABLE 4.12.2-3

Offshore and Coastal Dispersion Model Emissions and Exhaust Parameters for Aguirre Plant Modeled Sources [a] for the Aguirre Offshore GasPort Project

Source Description	NO_x (lb/hr [g/s])	CO (lb/hr [g/s])	PM_{10} / $PM_{2.5}$ (lb/hr [g/s])	SO_2 (lb/hr [g/s])	Stack Heigh t (m)	Stack Temp (F [K])	Stack Diameter (ft [m])	Exit Velocity (ft/s [m/s])	Stack Angle (D_{eg})	Grd-level Elev (ft [m])
Steam Boiler 1 (per stack, total of 2 stacks)	610.6 (76.934)	80.8 (10.182)	24.7 (3.116)	1.5 (0.193)	249.3 (76.0)	300.7 (422.4)	14.00 (4.27)	86.52 (26.37)	0	33 (10)
Steam Boiler 2 (per stack, total of 2 stacks)	610.6 (76.934)	80.8 (10.182)	24.7 (3.116)	1.5 (0.193)	249.3 (76.0)	300.7 (422.4)	14.00 (4.27)	86.52 (26.37)	0	33 (10)
Combined Cycle Turbine 1 (per turbine, total of 4 turbines)	46.8 (5.902)	14.2 (1.795)	4.2 (0.529)	0.5 (0.0567)	58.1 (17.7)	424.1 (491.0)	15.65 (4.77)	60.43 (18.42)	0	23 (7)
Combined Cycle Turbine 2 (per turbine, total of 4 turbines)	46.8 (5.902)	14.2 (1.795)	4.2 (0.529)	0.5 (0.0567)	58.1 (17.7)	424.1 (491.0)	15.65 (4.77)	60.43 (18.42)	0	23 (7)

a Exhaust temperatures and velocity based on 2010 ICR testing. Emission rates based on gas fired operation. Oil fired NO_x emission rates as follows: Boiler: 73.471 g/s (per stack), CC Turbines: 47.87 g/s (per turbine).

Ozone Limiting Method NO_2 Calculations

The Ozone Limiting Method procedures were also used to calculate ground level 1-hour NO_2 concentrations. The 1-hour NO_2 modeling also takes credit for the emissions reductions associated with the Aguirre Plant sources firing oil since this existing operating scenario would not take place during operation of the Offshore GasPort. These Ozone Limiting Method calculations were conducted to provide more realistic (but still conservative) estimates of the maximum 1-hour NO_2 concentrations.

Offshore and Coastal Dispersion Model Results

Maximum cumulative OCD-predicted impact concentrations are presented in table 4.12.2-4, along with ambient background concentrations, and the totals are compared to the NAAQS. OCD-predicted concentrations are presented for both the standard statistical basis associated with each the pollutant NAAQS, as well as for the maximum highest first highest (H1H) values for conservatism.

As shown in table 4.12.2-4, the total cumulative impact concentrations including background are less than the NAAQS for all pollutants and averaging periods.

Based on the analysis above and the proposed mitigation measure, we conclude that operation of the Aguirre Plant/Offshore GasPort would not result in significant cumulative impacts on air quality. Further, the proposed Project would allow the Aguirre Plant to convert a portion of its fuel source from No. 6 and No. 2 fuel oil to natural gas, reducing the emissions at the Plant, thereby resulting in a cumulative improvement in the local and regional air quality.

TABLE 4.12.2-4

Offshore and Coastal Dispersion Model Results for All Aguirre GasPort Project and Power Plant Sources Combined With Ambient Background for Comparison with National Ambient Air Quality Standards

Pollutant	Averaging Period	Rank [a]	Maximum Predicted OCD concentration (μg/m^3)	Ambient Background (μg/m^3)	Total Concentration (μg/m^3)	NAAQS (μg/m^3)
CO	1-Hour	H1H	150.5	18,370	18,520.5	40,000
CO	1-Hour	H2H	128.5	18,370	18,520.5	40,000
CO	8-Hour	H1H	96.9	4,846	4,942.9	10,000
CO	8-Hour	H2H	77.8	4,846	4,923.8	10,000
NO_2	1-Hour	H1H	128.9	56.4	185.3	188
NO_2	1-Hour	98% [b]	108.0	56.4	164.4	188
NO_2	Annual	H1H	35.3	27.5	62.8	100
$PM_{2.5}$	24-Hour	H1H	5.0	18.2	23.2	35
$PM_{2.5}$	24-Hour	98% [c]	3.8	18.2	22.0	35
$PM_{2.5}$	Annual	H1H	1.1	6.2	7.3	12
PM_{10}	24-Hour	H1H	5.0	77.5	82.5	150
PM_{10}	24-Hour	H2H	4.1	77.5	81.6	150
SO_2	1-Hour	H1H	142.9	50.7	193.6	196
SO_2	1-Hour	99% [d]	93.3	50.7	144.0	196
SO_2	3-Hour	H1H	81.9	38.3	120.2	1300
SO_2	3-Hour	H2H	71.6	38.3	109.9	1300
SO_2	24-Hour	H1H	32.2	33.3	65.5	365
SO_2	24-Hour	H2H	29.9	33.3	63.2	365
SO_2	Annual	H1H	8.3	11.0	19.3	80

[a] OCD-predicted concentrations are presented for both the typical statistical ranking associated with the pollutant NAAQS, as well as for the maximum highest first highest (H1H) values for conservatism, since 1 year of meteorological data were used in the modeling analysis.

[b] The ninety-eighth percentile (98 percent) 1-hour NO_2 concentration corresponds to highest eighth highest (H8H) predicted value.

[c] The ninety-eighth percentile (98 percent) 24-hour $PM_{2.5}$ concentration conservatively represented by highest fifth highest (H5H) concentration.

[d] The ninety-ninth percentile (99 percent) 1-hour SO_2 concentration corresponds to highest forth highest (H4H) predicted value.

4.12.2.3 Climate Change

Climate is an observation of a given area's weather over a long period of time. Climate change is the term used to describe the change in climate over time and is generally attributed to human activity or natural variability (EPA, 2014b). The climate in Puerto Rico is generally categorized as tropical monsoon in the Köppen-Geiger Climate Classification System, which is characterized by a pronounced wet season and short dry season.

The Intergovernmental Panel on Climate Change (IPCC), which was established by the United Nations Environment Programme and the World Meteorological Organization in 1988, is the leading international body for the assessment of climate change. The United States is a member of the IPCC and participates in the IPCC working groups to develop reports on climate change. The U.S. Global Change Research Program (USGCRP) is a confederation of the research arms of 13 Federal departments and agencies, which carry out research and develop and maintain capabilities that support the U.S. response to global change.

Both the IPCC and USGCRP have concluded that, over the last half century, climate change is being driven primarily by human activities which release heat trapping GHGs (IPCC, 2013; USGCRP, 2014). In 2014, the USGCRP published the most recent National Climate Assessment for the United States, which assesses the science of climate change and its impacts across the country. The USGCRP's report notes the following observations of environmental impacts that may be attributed to climate change in the Southeast and Caribbean region of the United States:

- the Caribbean exhibits a trend since the 1950s, with increasing numbers of very warm days and nights, and with daytime maximum temperatures above 90 °F and nights above 75 °F;
- increasing temperatures and the associated increase in frequency, intensity, and duration of extreme heat events will affect public health, natural and built environments, energy, agriculture, and forestry;
- decreased water availability, exacerbated by population growth and land-use change, will continue to increase competition for water and affect the region's economy and unique ecosystems;
- sea level rise, attributable to climate change, poses widespread and continuing threats to both natural and built environmental and the regional economy; and
- daily and five-day rainfall intensities have increased.

The GHG emissions associated with construction and operation of the Project are discussed in more detail in section 4.10.1. Several commenters requested that a more in-depth cumulative impact analysis be prepared for GHG emissions, including requesting the GHG emissions associated with the full lifecycle of the Project. FERC staff completed an impact analysis that was appropriate for the scale of the Project. In reference to predicting climate change impacts, FERC staff used guidance provided by the CEQ in their February 18, 2010 memorandum titled "Draft NEPA Guidance on Consideration of the Effect of Climate Change and Greenhouse Gas Emissions," which states that "agencies should recognize the scientific limits of their ability to accurately predict climate change effects, especially of a short-term nature, and not devote effort to analyzing wholly speculative effects." On December 18, 2014, the CEQ released a revised draft GHG emission guidance memo. As recommended in this new guidance, to the extent practicable, FERC staff incorporated additional guidance provided by this memo into the GHG analysis completed for the Project. As such, FERC staff has presented the GHG emissions associated with the Project and the potential impacts of GHG emissions in relation to climate change. There is no current methodology or policy guidance to determine how the Project's incremental contribution to GHGs would translate into physical effects on the global environment. However, the emissions would increase the atmospheric concentration of GHGs, in combination with past and future emissions from all other sources, and contribute incrementally to climate change that produces the impacts described above. The net annual increase in future potential GHG emissions for the combined Project is equal to 0.1 percent of Puerto Rico's reported GHG emissions for 2011 (see section 4.10.1.5). However, it cannot be determined whether or not the Project's contribution to cumulative impacts on climate change would be significant.

4.12.2.4 Noise

As discussed in section 4.10.2, noise would be generated during construction of the Project facilities and during the operation of the Offshore GasPort. Noise during construction would be short-term spanning approximately 1 year. Various phases of construction would include marine infrastructure components, offshore components, and installation of the subsea pipeline. Noise generated during construction activities would not be expected to contribute to cumulative effects given the temporary duration.

Operation of the Project facilities would contribute to background noise levels although given the location of the Offshore GasPort from the nearest NSA, the cumulative impact would be minimal; less than 1 dB during any phase of operation. The noise associated with LNG carriers under transit would be comparable to the existing oil barges in the area. Currently, the Aguirre Plant receives fuel oil by barge at a rate of three to four barge deliveries per week, and the Project, if approved, would reduce oil barge traffic to as much as 90 percent (or 15 to 20 deliveries per year). As proposed, LNG carriers would deliver LNG to the Offshore GasPort every 8 days (or 48 deliveries per year). Considering that operation of the Project would reduce the fuel oil barge traffic in Jobos Bay, the comparatively lower frequency of LNG carriers to fuel oil barges in the Project area, and LNG carrier traffic would be at a greater distance to NSAs, we conclude that there would be no significant cumulative noise impacts on NSAs during standard operations of the Project.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF THE STAFF'S ENVIRONMENTAL ANALYSIS

The conclusions and recommendations presented in this section are those of the FERC environmental staff. Our conclusions and recommendations were developed with input from the EPA, USCG, DOT, DOE, USDA, PMO, EQB, PRPB, DNER, and PRDH. Permitting and consulting agencies such as the COE, FWS, NOAA, and NMFS also provided input. The federal cooperating agencies could adopt this EIS per 40 CFR 1506.3 if, after an independent review of the document, they conclude that their permitting requirements and/or regulatory responsibilities have been satisfied. These agencies would, however, present their own conclusions and recommendations in their respective and applicable decisions.

We determined that construction and operation of the Aguirre Offshore GasPort Project would result in limited adverse environmental impacts, provided the subsea pipeline does not cross the Boca del Infierno pass via a direct lay. These limited impacts would mostly occur during construction. This determination is based on a review of the information provided by Aguirre LLC and further developed from data requests; field investigations; scoping; literature research; alternatives analysis; and contacts with federal, state, and local agencies and individual members of the public; as well as our recommendations to avoid or reduce certain environmental impacts. As part of our review, we developed specific mitigation measures that we conclude would appropriately and reasonably reduce the environmental impacts resulting from construction and operation of the Project.

We find that environmental impacts would be reduced to less than significant levels if the proposed Project is constructed and operated in accordance with applicable laws and regulations, Aguirre LLC's proposed mitigation measures, and our additional recommended mitigation measures. While the proposed subsea pipeline design does meet DOT pipeline standards, we find that the installation method (direct lay with concrete matting) within the Boca del Infierno pass would adversely affect federally endangered coral resources and other sensitive benthic resources to the extent that we do not find this portion of the proposed pipeline to be environmentally acceptable.[1] We concluded that the proposed route would be environmentally acceptable if it includes the HDD method through the Boca del Infierno pass, substantially minimizing impacts on the federally listed coral resources and sensitive benthic habitat. However, as mentioned in section 3.6, Aguirre LLC's contractor concluded that a detailed subsurface exploration program would be required to determine the feasibility of an HDD to cross the Boca del Infierno pass. We are recommending that Aguirre LLC continue to conduct the necessary subsurface investigations to determine the feasibility and probability of success of using an HDD (see section 4.5.2.4). Because of the uncertainty of a successful HDD, and considering the comments received by NMFS and other agencies, we analyzed alternatives of the offshore portion of the proposed pipeline route. We are recommending that, if Aguirre LLC determines that the HDD is unlikely to be successful, it should adopt Alternative Route 6 as its proposed route. We are also recommending that our mitigation measures be attached as conditions to any authorization issued by the Commission. A summary of the anticipated Project impacts and our conclusions is provided, by resource area, below.

[1] In its letters dated October 31, 2013, and September 25, 2014, and additional correspondence, NMFS indicated that alternative measures be implemented to avoid or minimize impacts on federally endangered coral resources, either by a pipeline reroute or alternative installation methods. In its September 2014 letter, NMFS also points to an alternative route analyzed in the draft EIS containing lower quality coral habitat than along the proposed route. We agree. NMFS' comments are one of the driving factors for our recommendations, that would result in complete avoidance of the most sensitive and concentrated area of federally listed corals in the Project area (e.g., the Boca del Infierno pass). The COE, EPA, and DNER have provided additional support for implementing alternative installation methods or routes for avoidance of the coral resources in the Boca del Infierno pass.

5.1.1 Geologic Resources

The construction and operation of the Project would have minimal impacts on the geologic resources of the area. However, hazards such as seismic ground motion, liquefaction events, wind and wave loadings, and tsunamis could impact the Project during operation. Aguirre LLC has proposed a feasible design and it has committed to conducting a significant amount of detailed design work for the Project if it is authorized by the Commission. Information regarding the final design would need to be reviewed by FERC staff in order to ensure that the final design addresses the requirements identified in the FEED. Therefore, we are recommending that Aguirre LLC file:

- a revised seismic hazard analysis report;
- additional studies on the pipeline route seafloor slope angles and liquefaction potential along the alignment and mitigation measures as needed;
- revised offshore wave analyses;
- offshore berthing platform structures and pile foundation design and calculations;
- seismic specifications used in conjunction with the procuring equipment;
- quality control procedures to be used for design and construction; and
- identification of a special inspector employed by Aguirre LLC to observe the construction of the Project and furnish inspection reports.

5.1.2 Soils and Sediments

Impact on soils within the Project area would be limited to the 1.5 acres (1.5 cuerdas) required for the onshore temporary staging and support area. This area is within the existing Aguirre Plant property and has been disturbed by past industrial activities. Aguirre LLC would implement measures outlined in the FERC Plan and Procedures to minimize or avoid impacts associated with the onshore portion of the Project and ensure proper restoration of disturbed areas following construction.

Construction activities, including the installation of the subsea pipeline and permanent structures at the Offshore GasPort, would result in the resuspension of seafloor sediment into the water column. Relatively rapid settling rates for coarse sand found in the Offshore GasPort area, coupled with the local current speeds, suggest that resuspended sediments would not persist in the water column beyond the actual time of construction. However, the most widespread sediment type found along the pipeline route is a sandy mud that consists of coarse shell debris mixed with carbonate mud and fine-grained terrigenous mud. When suspended during construction, the fine silt particles that characterize this material would descend through the water column relatively slowly and could travel hundreds of yards (hundreds of meters) under mean current speeds due to the spatial and temporal asymmetry of the tidal currents. Although pipeline construction is scheduled over a continuous 3-month period, installation would be on a sequential, segment-by-segment basis, such that associated sediment resuspension and elevated turbidity would be localized at any given point in time; it would not occur simultaneously along the entire pipeline route nor for extended periods of time in any one area.

We conducted an independent analysis of sediment transport during construction and operations. The results of the sediment transport analysis concluded that maximum suspended sediment concentrations would reach 1,620 mg/L in the vicinity of Aguirre LLC's hand jet/suction pump pipe burying activities. However, concentrations would decrease to 50 mg/L or less within approximately 100 feet (30 m) of a majority of the construction area. Deposition rates would be highest along the pipeline, with a maximum deposition of approximately 0.7 inches (1.7 cm), but would be reduced to less than 0.04 inch (1 mm) within approximately 200 feet (61 m) of a majority of the construction area. Aguirre LLC proposes to use turbidity curtains to minimize sediment transport during the pipe burial procedures. To ensure the effectiveness of the turbidity curtains, we are recommending in section 4.5.2.4 that Aguirre LLC file with its Implementation Plan the protocol that would be used to determine the effectiveness of the turbidity curtains during construction.

Construction activities in Jobos Bay are not expected to cause widespread or significant impacts associated with the introduction of contaminants into the water column through resuspension of surficial sediments. The existing benthic infaunal community is regularly exposed to existing contaminants in the surficial sediments and the temporary resuspension of this material is not expected to exacerbate this exposure.

5.1.3 Water Resources

There are no groundwater or onshore surface water impacts anticipated with the construction and operation of the onshore portion of the Project. However, both temporary construction impacts and permanent operational impacts are anticipated for the offshore portion of the Project.

Construction of the Offshore GasPort would involve the placement and driving of deep-seated pilings into the seafloor to provide a foundation for the pier and mooring structures and the placement of mooring anchors and chains to secure the berthing platform. These activities would cause the displacement of sediments on the seafloor and the resuspension of sediments into the water column. Sediment disturbed during pipeline placement and burial would also be resuspended in the water column and transported by currents. The effects of the construction activities on turbidity levels would vary with the length and severity of disturbance, grain size composition, and resettling rates. Based on rapid settling rates and the results of the sediment transportation analysis, we concluded that construction activities in the areas with coarse sediments (outer Jobos Bay to the Offshore GasPort) would have only minor impacts on water quality, associated with short-term, localized turbidity increases. Construction along the remainder of the pipeline route would result in more widespread turbidity due to the prolonged resettling rates of the finer sediments found in that portion of the bay; however, concentrations would decrease to 50 mg/L or less within approximately 100 feet (30 m) of a majority of the construction area. In both cases, the temporary, sequential nature of pipeline installation activities would limit the temporal and spatial extent of sediment resuspension and turbidity. As such, overall water quality impacts would be relatively short-term and minor.

Seawater for hydrostatic testing would be pumped into the pipeline using portable, high volume pumps on the offshore lay barge. The water would be withdrawn from 6 feet (1.8 m) below the surface at a rate of 1.5 to 3 ft/sec (0.5 to 0.9 m/sec). The intake pipe would be fitted with a 100-micron (0.1-mm) screen to prevent the accidental intake of organisms. About 240,000 gallons (909 m^3) of water would be required to complete one full hydrostatic test of the 4.0-mile-long (6.4 km) pipeline. The test water would be discharged through a pipe secured about 6 feet (1.8 m) below the water surface to minimize surface disturbance. To reduce discharge velocity and prevent sediment resuspension at the point of discharge, a diffuser head would be attached to the discharge pipe during dewatering operations. No consumptive losses, temperature changes, or biocide treatment of the test water is anticipated.

Both the FSRU and LNG carriers would have operation-related cooling water withdrawals and discharges. The normal water use of the FSRU would total approximately 56 mgd (212,000 m^3/day) of seawater, including 53 mgd (200,600 m^3/day) to support machinery cooling through operation of the main condenser and auxiliary seawater cooling systems, 0.6 mgd (2,270 m^3/day) to generate the FSRU vessel's water safety curtain, and 2 mgd (7,200 m^3/day) for ballast water. All of the water used for these purposes would be discharged back into the surrounding ocean. LNG carriers would require about 17.2 to 74.2 million gallons (65,100 to 280,900 m^3) of water for ballast while offloading at the Offshore GasPort and a total cooling water intake volume would range from about 13.5 to 227.8 million gallons (51,100 to 862,300 m^3) during LNG delivery. Therefore, the combined water intake for ballast and cooling water for each LNG delivery would range from about 31 to 302 million gallons (116,200 to 1,143,200 m^3).

Seawater uptake by FSRUs and visiting LNG carriers would not cause any significant change in ambient water quality, given the negligible volume removed relative to the surrounding ocean. Water discharges have the potential to impact ambient water quality and biotic communities where discharge parameters fail to meet standards and thresholds, generally embodied in regulations and permit conditions. Temperature standards are of particular significance here, based on the magnitude of the predicted cooling water discharges from the FSRU and visiting LNG carriers. All operational discharges would be subject to the requirements of the NPDES permit for the Project. Elevated temperature levels can have sub-lethal or lethal effects on marine biota, depending on the magnitude and duration of the increase. Similar effects can occur if other contaminants, such as oil, grease, and metal particulates, are present in discharge water.

Spills or leaks of hazardous materials (e.g., fuel, lubricants) from equipment working in the onshore areas could also result in adverse impacts on water resources. Construction contractors and port operations personnel would be required to comply with all laws and regulations. We are recommending that Aguirre LLC file a site-specific spill prevention and control plan for the construction and operation phases of the Project prior to construction.

5.1.4 Vegetation Resources

Based on the sparse vegetation within the proposed onshore temporary workspace area, no significant impacts on terrestrial vegetation resulting from construction or operation of the Project are anticipated.

Offshore construction activities such as vessel anchoring (use of spud-legs), pipe laying, and pile driving would result in direct impacts on approximately 22.6 acres (23.3 cuerdas) of seagrass and 80.8 acres (83.1 cuerdas) of macroalgal habitat. The operation of the Offshore GasPort would result in permanent impacts on approximately 2.9 acres (3.0 cuerdas) of seagrass and 19.2 acres (19.8 cuerdas) of macroalgal habitat. Habitat loss due to the placement of concrete mats over portions of the pipeline would result in permanent impacts on approximately 0.01 acre (0.01 cuerda) of seagrass and 0.02 acre (0.02 cuerda) of macroalgae. However, we are recommending that Aguirre LLC use an HDD to cross the Boca del Infierno pass; or, if the HDD is infeasible, to construct the subsea pipeline along an alternative route. In either case, the use of concrete mats would be reduced. Further, it is anticipated that seagrasses and macroalgae would recolonize where the pipeline is buried and where there are no concrete mats.

Aguirre LLC has agreed to finalize its Benthic Resources Mitigation Plan in consultation with the respective agencies to offset short-term impacts on seagrass communities. The plan includes pre-construction surveys in Jobos Bay to map and quantify seagrass restoration sites and identify reference sites, seagrass planting and relocation, post-construction surveys to assess and address any potential construction damage, and monitoring of restoration sites and transplant areas. We are recommending in section 4.4.3 that, prior to construction, Aguirre LLC finalize and file the Benthic Resources Mitigation Plan, along with agency comments, for review and written approval by the Director of OEP. In addition, to ensure impacts on seafloor vegetation are minimized to the extent practicable, we are recommending in section 4.4.3 that Aguirre LLC provide in its implementation plan measures how it would maintain the pipe afloat to prevent inadvertent pipe lay on the seafloor.

5.1.5 Wildlife Resources

Temporary impacts on marine wildlife habitats from the Offshore GasPort and subsea pipeline, as proposed, include 22.6 acres (23.3 cuerdas) of seagrass, 80.8 acres (83.1 cuerdas) of macroalgae, and 6.2 acres (6.4 cuerdas) of reef habitat. Construction of the Project would result in short-term adverse impacts on a rich and diverse assemblage of wildlife species including manatees, sea turtles, reef fish, sharks, corals, and invertebrates found within these habitats. The most likely effects would be the general avoidance or isolation from preferred habitat due to construction activities. Marine mammals and sea turtles would also be exposed to an elevated risk of vessel strikes during the construction period because the number of vessels present in the area would increase from current traffic levels. To minimize the entrainment of fish and other organisms during hydrostatic testing, we are recommending in section 4.5.2.4 that Aguirre LLC consult with NMFS regarding the type of screen (e.g., wedge wire) that will be used for water withdrawals during construction.

Permanent impacts on marine wildlife habitat include 2.9 acres (3.0 cuerdas) of seagrass, 19.2 acres (19.8 cuerdas) of macroalgae, 0.6 acre (0.6 cuerda) of reef, and 0.2 acre (0.2 cuerda) of sand/mud. Major direct impacts would result from mortality of coral colonies within the footprint of the proposed pipeline across the reef. Major indirect impacts on species would result from shading of patch reef below the Offshore GasPort (including the permanent FSRU and temporary LNG carrier) and degradation of seagrass and macroalgae foraging habitats. The FSRU and LNG carriers stationed at the Offshore Gasport would also locally impact wildlife resources with thermal plume and anti-fouling agent discharge, plankton entrainment, noise, and lighting.

Aguirre LLC intends to utilize several mitigative measures to minimize these impacts including the use of marine mammal observers to ensure vessel strike reduction, noise exclusion zones around pile driving activities, the potential use of bubble curtain technology during pile driving activities, development of a benthic resource restoration plan, and development of a lighting plan to reduce impacts to various wildlife species and life forms.

To ensure that impacts on coral reef habitat are minimized or avoided to the extent practicable, we are recommending in section 4.5.2.4 that Aguirre LLC file with its Implementation Plan the detailed geotechnical analysis for the HDD of the Boca del Infierno pass and provide a determination on whether the HDD would be a viable construction method for avoiding the pipeline's impacts on the coral reef habitat. If the HDD is determined to be a viable construction method, we are recommending that Aguirre LLC use an HDD to cross the Boca del Infierno pass.

Aguirre LLC's draft Benthic Resources Mitigation Plan contains objectives to avoid and minimize impacts on epibenthic flora and fauna by transplanting seagrass and relocating coral species [2] from within the construction footprint prior to construction, provide mitigation for loss of critical habitat for *Acropora* spp., provide mitigation for impacts to foraging habitat for the green sea turtle and Antillean manatee, and offset impacts on EFH. We are recommending in section 4.4.3 that, prior to construction, Aguirre LLC should consult with the respective agencies to finalize the Benthic Resources Mitigation Plan to: 1) address the currently proposed construction and operation impacts, 2) include the seagrass that would be permanently impacted by shading, 3) comply with the standard requirements found in the COE's Compensatory Mitigation Rule under the CWA Section 404 regulatory program, and 4) identify

[2] In its September 26, 2014 letter, the EPA notes that replacement and relocation of seagrass and coral has been attempted within the Project area only to result in limited success.

measures that would be implemented if the seagrass mitigation sites are not trending towards success. The Benthic Resources Mitigation Plan should be filed, along with agency comments for review and written approval by the Director of OEP.

The majority of the pipeline would be laid directly on the seafloor then lowered by hand jetting/suctions method to achieve required depths. Burial of the pipeline using hand-jetting/suction techniques would result in the resuspension of finer sediments, but the increased turbidity is expected to be minor. Aguirre LLC would use a diffuser head fixed to the pump in combination with turbidity curtains to help redirect a majority of the suspended sediments back to the construction right-of-way. The transport of fine sediments beyond the construction right-of-way would likely occur. The turbidity curtains would minimize sedimentation transport during pipeline construction activities, which we anticipate would reduce the deposition levels within the coral reef area. To ensure the effectiveness of the turbidity curtains, we recommend in section 4.5.2.4 that Aguirre LLC file with its Implementation Plan the protocol that would be used to determine the effectiveness of the turbidity curtains during construction.

Aguirre LLC proposes to lay concrete mats on the seafloor in the coral reef area and where the pipeline bends. We are recommending the pipeline in the coral reef area be installed via an HDD or an alternate route. The areas where the pipeline and/or concrete mats would be above grade may present a barrier to migration for conch, urchins, sea cucumber, and other mobile benthic organisms. This potential barrier could present a permanent, minor impact for these species. We are recommending in section 4.5.2.4 that Aguirre LLC conduct 5 years of post-construction monitoring to determine if benthic organisms have colonized areas where the pipeline and/or concrete mats are above grade, and to include the plan for monitoring in the Benthic Resources Mitigation Plan. To further protect the wildlife resources that occur near the subsea pipeline that could be adversely affected by the unanticipated relocation of concrete mats, we are recommending in section 4.5.2.4 that Aguirre LLC file with its Implementation Plan a description of the measures that would be used, in addition to lowering the mat edges, to secure all the concrete mats to the seafloor.

Aguirre LLC has outlined several protocols that would be followed by MMOs to ensure vessel strike reduction during construction activities. To ensure impacts on marine mammals and sea turtles during construction and operation of the Project are minimized or avoided, we are recommending in section 4.5.3.3 that Aguirre LLC coordinate with the FWS, NMFS, and DNER to develop a detailed MMO training and response protocol plan for the construction and operation phases of the Project, which should incorporate the FWS's manatee conservation measures for in-water work, where applicable, and detail daytime and speed restrictions for the transit of crew boats during construction and operation.

Aguirre LLC conducted modeling to determine the anticipated net reduction in noise with the implementation of bubble curtain technology during impact pile driving. In order to properly conduct noise mitigation measures during construction to reduce impacts on marine mammals and sea turtles near the Project area we are recommending that, prior to construction, Aguirre LLC verify that it would use confined bubble curtains when conducting vibratory and hammer pile activities. We are further recommending that Aguirre LLC develop a detailed noise mitigation protocol for the safety exclusion zone (0.3 mile [0.5 km]) that identifies when the noise mitigation protocol would be implemented during construction and explains how each MMO would identify the limits of the exclusion zone.

Several species of birds may be found in the Project area but are not expected to be affected by the Project due to the nature of construction, the species behavioral characteristics, and preferred habitats. These birds are expected to avoid any impacts that may cause them discomfort or harm, such as noise, by leaving the area. To ensure that impacts on birds are minimized or avoided, we are recommending in section 4.5.3.3 that Aguirre LLC provide an assessment of potential noise impacts on resting and nesting birds during the construction and operation of the Project, and identify mitigation measures that could be implemented to minimize or avoid these impacts.

The Project would necessitate the installation of temporary lighting to facilitate construction activities during evening hours as well as for safety requirements. The Offshore GasPort would be lit 24 hours per day by security lighting, navigation lights, and Federal Aviation Administration warning lights. To minimize lighting effects during operation, Aguirre LLC would implement certain measures, such as to limit the number and wattage of operational lights to the minimum possible for safe operations so as to minimize illumination of surrounding waters.

The waters surrounding the Offshore GasPort are unlit due to the lack of permanent structures in the water and on uninhabited Cayos de Barca and Cayos Caribes. The response of marine organisms to artificial lights can vary depending on a number of factors such as the species, life stage, and the intensity of the light. Therefore, the nighttime lighting contrast between the Project and the background would be high. To minimize operational impacts associated with nighttime lighting, we are recommending in section 4.5.3.3 that Aguirre LLC develop a lighting plan that identifies specific measures that would be implemented to minimize or avoid impacts associated with the Project's operational nighttime lighting on avian species, fish species, marine mammals, and individuals on the shoreline. The plan should also analyze if the Project could artificially induce biological aggregations, and the analysis should provide empirical evidence of how these potential aggregations could affect local fisheries and tourism.

Minor releases of hydrocarbons during construction could result in short-term, minor-to-moderate adverse impacts on protected species. Accidental releases of hydrocarbons resulting from operation of the Project are expected to have short-term and minor-to-moderate impacts on protected species. To ensure that inadvertent hydrocarbon spill impacts on federally listed species and migratory birds are minimized or avoided, we are recommending in section 4.5.3.3 that prior to construction Aguirre LLC file, as a part of its site-specific spill prevention, and control plan, a response plan that identifies measures that it would implement if wildlife, including federally listed species or migratory birds, are affected by an inadvertent hydrocarbon spill.

Operational and construction-related uses of seawater have the potential to adversely affect populations of queen conch, Nassau grouper, and protected corals via entrainment of larval stages. The coral entrainment analysis used data based on 1 day of sampling within a 9-day sampling event in August 2013, which may not represent typical post-spawning larval densities for many species. Aguirre LLC is currently developing, in discussion with appropriate agencies, a pre-operations coral larvae baseline survey and monitoring plan. The plan would help to further characterize the coral larvae at the proposed Offshore GasPort to understand the potential impacts associated with proposed water use for construction activity and operations. In addition, the plan would outline an analysis of potential impingement impacts on Nassau grouper that are larger than larval size that may congregate near the seawater intakes at the platform. The results of the grouper impingement analysis, the ichthyoplankton and coral larvae baseline survey results and monitoring plan, and the mitigation measures for entrainment impacts would be filed.

5.1.6 Threatened and Endangered Species

To comply with Section 7 of the ESA, we are consulting with the FWS and NMFS regarding the presence of federally listed or proposed species in the Project area. The DNER is also providing technical assistance and resource expertise regarding sensitive species. We have identified 23 federally listed threatened or endangered species and 10 species proposed for ESA listing occurring or potentially occurring in the Project area. Since the filing of the draft EIS, several species were formally listed and/or removed from their proposed listing status. Due to the distance of their primary habitat from the Project area, it was determined that the Project would have no effect on 13 of the listed species and may affect, but is not likely to adversely affect 12 listed or proposed species based on behavioral characteristics, habitat requirements and the construction, operation and mitigative measures proposed by Aguirre LLC.

We have determined that the construction and/or operation of the proposed Project is likely to adversely affect the Antillean manatee and seven species of listed corals. With construction of the subsea pipeline, as proposed, permanent impacts on ESA-listed corals are expected to result in direct mortality of colonies within the footprint of the pipeline. If our recommendations regarding the Boca del Infierno pass are adopted by Aguirre LLC or required by the Commission, impacts on the federally listed corals would be greatly reduced. As such, we are not attempting to finalize our Section 7 consultation with the NMFS or FWS at this time. We will continue our required Section 7 ESA consultation with the FWS and NMFS once the disposition of the subsea pipeline route is finalized. We are recommending in section 4.6 that Aguirre LLC not begin construction of the Project until: 1) we receive comments from the FWS and NMFS regarding the proposed or authorized action, 2) we complete any necessary Section 7 consultation with the FWS and NMFS, if required, and 3) Aguirre LLC has received written notification from the Director of OEP that construction or use of mitigation may begin.

The impacts associated with the construction phase of the Project are expected to be temporary; long lasting effects on manatees are not expected. During construction, manatees would be at an elevated risk for vessel strikes and degradation of foraging habitats. With mitigation techniques such as the use of trained MMOs and a 0.3-mile (0.5 km) zone of exclusion around pile driving activities, the risk of strikes and stress caused by excessive noise would be greatly reduced. To ensure impacts on marine mammals and sea turtles during construction and operation of the Project are minimized or avoided, we are recommending in section 4.5.3.3 that Aguirre LLC coordinate with appropriate agencies to develop a detailed MMO training and response protocol plan for the construction and operation phases of the Project. In addition, we are recommending that, prior to construction, Aguirre LLC verify that it would use confined bubble curtains when conducting vibratory and hammer pile activities.

5.1.7 Land Use, Recreation, and Visual Resources

Jobos Bay and the surrounding areas are used for a variety of marine activities, including recreational boating, recreational and commercial fishing, scientific research, and other recreational activities such as snorkeling and wildlife viewing. Jobos Bay and the open sea south of the bay are also used by various shipping vessels, including the barges that currently deliver fuel oil to the Aguirre Plant. Construction of the Project would alter the land use, recreation, and visual resources of the area by temporarily increasing vessel traffic; therefore impacting recreational boating and fishing. Operation of the Project would permanently alter the existing visual resources as well as impact boating, fishing, and other marine uses near the Offshore GasPort.

Aguirre LLC stated that it plans to complete a coastal zone consistency evaluation with the PRPB to determine the Project's consistency with the CZMP policies. The COE requires a concurrence certification with CZMP from the PRPB prior to issuing a permit. To ensure that Aguirre LLC receives its determination of consistency with the CZMP, we are recommending in section 4.7.3 that Aguirre LLC not begin construction of the Project until it files with the Secretary a copy of the determination of consistency with the CZMP issued by the PRPB.

Construction activities would require the use of a variety of vessels including lay barges, dive support vessels, support tugs, crew boats, pipe transport barges, and pipe haul barge tugs. The presence of these vessels would represent a temporary increase in the current levels of large vessel traffic in the bay, which is typically limited to small recreation and commercial fishing vessels. The barges that deliver fuel oil to the Aguirre Plant utilize the dredged ship navigation channel to the west of the Project and would not likely be affected by construction activities. However, access to areas of active construction along the pipeline route would be temporarily restricted during construction for all non-construction boaters, including fishers, recreational boaters, and commercial vessels. Therefore, we are recommending that Aguirre LLC file a Construction Access Plan that clarifies areas that would be restricted to marine users, discusses the duration of any restrictions, and identifies methods of communication of restrictions to the general public.

Operation of the Project is not anticipated to affect marine use within Jobos Bay, as no restrictions on marine access would be placed along the pipeline route. However, the security zone established around the FSRU and LNG carriers would have a direct impact on boating, fishing, and other marine uses in the area.

Aguirre LLC conducted a visual assessment from three locations proximate to the Project area including Highway 53 in Guayama, the Salinas Marina inlet, and a lookout tower on Cayos Caribe. The FSRU would be apparent from the upland highway viewpoint and it would dominate the view from the Cayos Caribes lookout tower. The presence of the FSRU would visually affect wildlife viewing from the Cayos Caribes lookout tower and other places within the JBNERR that have views of the ocean. The red FSRU contrasts with the blue water and green landscape surrounding the Project area. The FSRU is less apparent from the Marina de Salinas, as the barrier islands partially obstruct the line of sight. Visual impacts from fuel oil barges would decrease after construction of the Project resulting in a more natural setting for viewers of the Jobos Bay area.

5.1.8 Socioeconomics

The construction and operation of the Project may have minor impacts on the existing socioeconomic conditions within the Project area. Potential impacts on populations could arise due to incoming workers associated with the Project. However, these impacts would be localized and temporary and would be limited to the influx of non-local workers and their family members. Construction of the Project is anticipated to require approximately 350 workers over a 12-month construction period. Aguirre LLC has stated it intends to hire at least 10 percent (35 workers) of the construction workforce locally.

The construction and operation of the Project is not anticipated to have an effect on the rental and occupancy rates of the local communities. The implementation of the Project would not result in any disproportionately high and adverse human health or environmental impacts on minority or low-income communities. Rather, the Project would result in improved air quality for the local citizens because emissions from burning fuel oil at the Aguirre Plant would be reduced.

5.1.9 Cultural Resources

The APE for the onshore portion of the Project is within the existing fenced Aguirre Plant property. The Project proposes to disturb approximately 1.5 acres (1.5 cuerdas) of the industrial site during the construction for use as a temporary construction staging and support area. The offshore construction would include the construction right-of-way and temporary workspace for the 4.0-mile-long (6.4 km) subsea pipeline and the construction area for the Offshore GasPort. Aguirre LLC conducted archival research and marine surveys of these areas to identify cultural resources including locations for potential prehistoric and historic archaeological sites.

No sites were identified through archival research within the Project area. The NRHP-listed Central Aguirre Historic District is located outside of the Project area but within the viewshed of the Project. In an email dated February 7, 2013, the SHPO commented that the Central Aguirre Historic District does not appear to be affected by the proposed undertaking. We concur. Aguirre LLC did not conduct an archeological survey within the previously disturbed, terrestrial portion of the Project because of the low potential for intact cultural deposits. In a letter dated August 15, 2012, the SHPO concurred that no archaeological survey is necessary. We concur as well.

The marine APE includes about 155 acres (160 cuerdas) of submerged land that could be affected by the construction and operation of the subsea pipeline and the Offshore GasPort. Aguirre LLC completed evaluative testing in March 2013, prepared a report of findings in April 2013, and submitted a copy to the SHPO for review in June 2013. The archaeological assessment of 11 anomalies found during the surveys determined that they are modern marine debris and therefore are not recommended eligible for listing in the NRHP. In a letter dated July 2, 2013, the SHPO concurred that none of the reported anomalies were historically significant and that no further archeological work was required. We concur as well.

Based on the investigations conducted by Aguirre LLC, the comments received from the SHPO, and implementation of Aguirre LLC's unanticipated discoveries plan, we conclude that the Project would not affect any historical resources and that the FERC has met its responsibility under Section 106 of the NHPA.

5.1.10 Air Quality and Noise

Air quality impacts associated with construction of the Project include emissions from fossil-fueled construction equipment. Such air quality impacts would generally be temporary and localized, and are not expected to cause or contribute to a violation of the NAAQS. The operational air emission sources associated with the Project include equipment on the FSRU, the Offshore GasPort, LNG carriers, and support vessels and tugs. In response to federal and local requirements, BMPs have been included in Project design or proposed by Aguirre LLC to reduce air quality impacts. Potential impacts of operational air emissions would be reduced by incorporation of operating restrictions and use of emission reduction technologies on the FSRU to limit pollutant emissions. The overall effect of the Project would be an improvement in local and regional air quality as a result of the reduced emissions associated with a reduction in the burning of fuel oil at the Aguirre Plant.

Noise is expected to be generated during both construction and operation of the Project. Construction of the Offshore GasPort can be divided into three major components that feature different types of construction equipment and techniques. Although some phases would overlap, the three primary construction phases include the marine infrastructure including berth facilities, topside mechanical and electrical facilities, and the subsea interconnecting pipeline. Construction is anticipated to take approximately 12 months. Aguirre LLC would consult with the EQB to develop the appropriate mitigation measures should actual sound levels measured during construction activities exceed the nighttime EQB noise limits. If sound levels at residential areas onshore do not meet EQB criteria for an extended time, noise mitigation measures would be adjusted appropriately.

The operational noise of the FSRU has been calculated to be below existing ambient sound levels at each of the NSAs. However, we are recommending that Aguirre LLC file a noise survey no later than 60 days after placing the facilities into service to ensure compliance with our criteria of 55 dBA L_{dn} at the nearest NSAs. If the noise attributable to operation of the Offshore GasPort exceeds an L_{dn} of 55 dBA at any nearby NSAs, Aguirre LLC should file a report on what changes are needed and install additional noise controls to meet the level within 1 year of the in-service date. Aguirre LLC should confirm compliance with the above requirement by filing a second noise survey no later than 60 days after it installs the additional noise controls.

5.1.11 Reliability and Safety

Aguirre LLC has modified its pipeline facilities, which would be designed, constructed, operated, and maintained in accordance with or to exceed the DOT Minimum Federal Safety Standards in 49 CFR 192. These regulations, which are intended to protect the public and to prevent natural gas facility accidents and failures, include specifications for material selection and qualification; minimum design requirements; and protection of pipelines from internal, external, and atmospheric corrosion. On December 31, 2014, Aguirre LLC filed a draft O&M Manual in response to DOT's review of the subsea pipeline design, and further committed to providing the final O&M Manual as part of further design.

The USCG and the FERC share regulatory authority over the siting, design, construction, and operation of LNG import terminals located offshore. The FERC authorizes the siting and construction of LNG import and export facilities. The USCG regulates the safety of an LNG facility's marine transfer area and LNG marine traffic, and regulates security plans for the entire LNG facility and LNG marine traffic. Both agencies have some oversight and responsibility for inspection and compliance during the facility's operation.

Based on our technical review of the preliminary engineering designs, as well as our suggested mitigation measures, we conclude that sufficient layers of safeguards would be included in the facility designs to mitigate the potential for an incident that could impact the safety of the public. However, we are recommending that the final design be provided for further staff review and that the facility be subject to regular FERC staff technical reviews and site inspections on at least an annual basis.

All LNG vessels entering U.S. waters are required to be certified by the USCG as designed and operating in accordance with both international standards and the U.S. regulations for bulk LNG carriers. Current operational procedures in use by the USCG in U.S. ports, such as managing ship traffic, coordinating ship speeds, and active ship control in inner and outer harbors, would reduce the potential of LNG spill from accidental causes. The Offshore GasPort, FSRU, and LNG carriers would be subject to stringent requirements for security plan development and approval by the USCG and other applicable agencies, which would reduce the potential of an LNG spill from intentional causes.

The USCG determined that the waterway along the proposed LNG carrier transit route would be suitable for the type and frequency of LNG marine traffic associated with this proposed Project. However, the USCG's conclusion is contingent upon implementation of the recommended measures, outlined in the LOR Analysis, to responsibly manage the maritime safety and security risks. If the Project is approved and the appropriate resources were not put into place, then neither the FERC nor the USCG would allow the Project to commence service. By designing and operating the proposed Project in accordance with the applicable standards and the recommendations from us and the USCG, the Project would represent only a slight increase in risk to the nearby public.

5.1.12 Cumulative Impacts

Six past, present, and reasonably foreseeable actions have been identified within close proximity to the Project area. These actions include the construction of the AES Ilumina Solar Photovoltaic Power Plant, the Salinas Solar Park, and the Guayama-Punta Pozuelo Boardwalk, the renovation of the Aguirre Plant for natural gas capabilities, the development of a master plan for the renovation of Aguirre, and construction/renovation plans found in the JBNERR management plan.

Construction of the Project would primarily affect water quality by causing temporary increases in turbidity from the installation of the Offshore GasPort and subsea pipeline. These impacts would dissipate quickly following construction. Existing sources of water quality impacts within the Project area include sediment disturbance from barges and recreational vessels in shallow waters, the potential for spills from barges and recreational vessels using Jobos Bay, and non-point source runoff from the land surrounding Jobos Bay. There are currently no known proposed projects that would directly affect water quality within Jobos Bay and that would occur during the Project construction period. Therefore, water quality impacts of the Project when considered cumulatively with other projects would not be significant.

Based on the cumulative air quality analysis of the Project in section 4.12.2.2, the proposed mitigation measures, and the EPA's imposed permit conditions as part of the PSD Non-applicability determination, we conclude that operation of the Project would not result in significant cumulative impacts on air quality. Further, the Project would allow the Aguirre Plant to convert a portion of its fuel source from No. 6 and No. 2 fuel oil to natural gas, reducing the emissions at the Aguirre Plant, thereby resulting in a cumulative improvement in the local and regional air quality.

Noise generated during construction of the Project facilities would be short-term spanning approximately 1 year and is not expected to contribute to cumulative effects given the temporary duration.

Operation of the Project facilities would contribute to background noise levels although given the location of the Offshore GasPort from the nearest NSA, the cumulative impact would be minimal; less than 1 dB during any phase of operation. The noise associated with LNG carriers under transit would be comparable to the existing oil barges in the area. Considering that operation of the proposed Project would reduce the fuel oil barge traffic in Jobos Bay, the comparatively lower frequency of LNG carrier traffic to the existing fuel oil barge traffic in the Project area, and the larger distance of LNG carrier traffic to NSAs, we conclude that there would be no significant cumulative noise impacts on NSAs during standard operations of the Project.

5.1.13 Alternatives

As an alternative to the proposed action, we evaluated the No-Action Alternative, System Alternatives, Terminal Site Alternatives, Pipeline Route Alternatives, Pipeline Route Variations, and Vaporization Alternatives. While the No-Action Alternative would eliminate the short- and long-term environmental impacts identified in the EIS, the stated objectives of Aguirre LLC's proposal would not be met. We also evaluated the use of alternative energy sources and the potential effects of energy conservation, but determined that these sources and measures would not be a practicable alternative to the proposed Project.

One system alternative would be the expansion of the existing EcoEléctrica facility, which is approximately 35 miles (56 km) east of the Aguirre Plant. For the EcoEléctrica facility to be a viable system alternative to the proposed Project, the facility would have to construct new LNG storage capacity, regasification facilities, and a new pipeline to connect the EcoEléctrica facility to the Aguirre Plant. A pipeline connecting these facilities, the Gasoducto Del Sur, was proposed by PREPA and initial construction began in 2008, but by 2009 was cancelled due to significant public opposition. It is therefore unlikely and uneconomical to try to revive the failed pipeline. To accommodate the facilities required for this alternative, the EcoEléctrica facility would need to construct an additional LNG storage tank. When originally proposed, EcoEléctrica planned to construct two storage tanks. To date, EcoEléctrica has only constructed one storage tank. For this expansion to be a viable alternative to the proposed action, EcoEléctrica would have needed to start its FERC permitting process in 2012 to obtain approval to construct its tank. As the proposed Project does not require construction of onshore LNG storage or additional gasification facilities, the expansion at the EcoEléctrica facility would result in greater environmental impacts than the proposed Project.

In addition to the alternative of constructing an additional tank and new pipeline to the facility, we received a request during the comment period on the draft EIS to consider trucking the required LNG to the facility. It was noted that FERC had recently approved expansion at the EcoEléctrica facility to allow delivery of LNG to a proposed non-jurisdictional LNG truck loading facility (LNG Truck Loading Facility), which is being developed and permitted by Gas Natural Puerto Rico, Inc. Gas Natural Puerto Rico, Inc. is marketing its LNG to end-users in Puerto Rico, such as pharmaceutical, petrochemical, and other industrial facilities. We reviewed the capacity of the facility, the number of trucks required to deliver gas to the Aguirre Plant (227 trucks per day), and the impacts on the roads and communities with the number of trucks arriving and departing the facility each day. We determined that transporting the LNG to the Aguirre Plant by truck was not an environmentally preferable alternative to the proposed Project and it was removed from further consideration

We conclude that the expansion of the existing EcoEléctrica facility by tank and pipeline or by a trucking facility would not be considered environmentally preferable to the proposed Project.

Our evaluation of alternative sites also considered construction and operations of two land-based sites and two dockside sites. Las Mareas Bay is approximately 6 miles (10 km) east of the Aguirre Plant with access to the area off Puerto Rico Highway 3. This industrial area has sufficient land to allow for the development of an onshore LNG facility; however, it would require the construction of a new onshore or dockside terminal, a large dredging and bay development project to accommodate large LNG carriers, and a 6-mile (10 km) pipeline to the Aguirre Plant. Impacted areas would mainly consist of previously developed upland but would also include areas of palustrine emergent wetland located along the coastal area. We concluded that the associated environmental impacts with this alternative would be greater than the proposed Project. For these reasons, we conclude that a new land-based or dockside LNG facility within Las Mareas Bay would not present any significant environmental advantage compared to the proposed Project.

The Aguirre Plant was also considered to be utilized as either a land-based or dockside terminal location. It is estimated that 30 acres (31 cuerdas) would be required to construct storage tanks, regasification equipment, and other infrastructure to support the facility. In reviewing the area around the Aguirre Plant, 30 contiguous acres (31 cuerdas) were not available that would avoid population centers. In addition, the land-based terminal would require deepwater access and a turning basin. The lack of available land, the need to create a deepwater access and turning basin, and the proximity to a population center makes a land-based terminal less environmentally preferable than the Proposed Action. A dockside terminal facility would also require deepwater access and a turning basin large enough for both the FSRU and the LNG carrier, as well as modification at the plant to build a dock for the FSRU. The existing jetty at the facility cannot accommodate an FSRU as well as the LNG carrier. Considering its proximity to the Aguirre community, and the extensive amount of in-water work (dredging and pier construction) that would be required, we consider that the environmental impacts would be equal or greater than the proposed Project, and did not evaluate this alternative further.

We evaluated four alternative offshore terminal sites with pipelines to the terminal and conducted field review of each site and corresponding pipeline. The four terminal sites have similar water depths and seafloor conditions; however, the length of pipeline required and distance to the closest population centers varied. We also analyzed six terminal/pipeline alternatives in response to concerns from the public and NMFS, EPA, FWS, and DNER concerning impacts from the proposed pipeline route through Boca del Infierno pass on federally threatened and endangered coral species, coral reef habitat, seagrass within Jobos Bay, and the Antillean manatee. The objective of each alternative was to minimize the impacts on environmentally sensitive resources, which includes federally threatened and endangered species, recreational users, and general population areas. Aguirre LLC has modified its construction method to bury the pipe in all areas except for the 1,700 feet (518 m) located within the Boca del Infierno pass. Aguirre LLC now proposes to direct lay the pipe over the top of the coral reef in this area and protect the pipeline with concrete mats.

Aguirre LLC conducted additional work to determine the feasibility and risk of installing the pipeline through the Boca del Infierno pass using the HDD construction method. Based on a review of the geotechnical subsurface data and the preliminary nearshore geotechnical investigation conducted for the Project, Aguirre LLC determined that a successful HDD of this area would likely be infeasible based on the subsurface geotechnical data currently available. Aguirre LLC's contractor concluded that a detailed subsurface exploration program would be required to determine the feasibility and detailed design of an HDD to cross the Boca del Infierno pass. We are recommending that Aguirre LLC continue to conduct the necessary subsurface investigations to determine the likelihood of a successful HDD. For our comparison of impacts, because the success of an HDD is unknown for the Boca del Infierno pass, our analysis assumes a direct lay through coral areas of the proposed route and each of the alternative routes. We do note however that significant impacts would be reduced if the HDD method is adopted by Aguirre LLC.

In our analysis, we do not identify any alternative route that would be environmentally preferable to the proposed route if the subsea pipeline is installed through the Boca del Infierno pass using the HDD method to avoid impacts on the coral reef. However, if such an HDD is not feasible, we have determined that the route through this location is not environmentally acceptable. Therefore, if, following Aguirre's additional geotechnical work, it is determined that the HDD is not a viable construction method, we are recommending that Aguirre LLC adopt Alternative Route 6 as its proposed route to connect the Offshore GasPort to the Aguirre Plant. While Alternative Route 6 is longer than the proposed route resulting in a greater area of temporary construction disturbance; it provides an environmentally feasible and practicable alternative to substantially reduce impacts on sensitive coral reef resources while meeting the proposed Project objectives.

Finally, we evaluated three pipeline route variations from the proposed terminal site to the Aguirre Plant. We determined that each of the terminal locations and pipeline routes would have environmental impacts greater than or similar to the proposed terminal location and pipeline, and did not evaluate these alternatives further.

5.2 FERC STAFF'S RECOMMENDED MITIGATION

If the Commission authorizes the Aguirre Offshore GasPort Project, we recommend that the following measures be included as specific conditions of the Commission's Order. We believe that these measures would further mitigate the environmental impacts associated with construction and operation of the proposed Project. In the following section, "file" means to file with the Secretary of the Commission.

1. Aguirre LLC shall follow the construction procedures and mitigation measures described in its application, supplemental filings (including responses to staff data requests), and as identified in the EIS, unless modified by the Commission's Order. Aguirre LLC must:

   a. request any modification to these procedures, measures, or conditions in a filing;

   b. justify each modification relative to site-specific conditions;

   c. explain how that modification provides an equal or greater level of environmental protection than the original measure; and

   d. receive approval in writing from the Director of OEP **before using that modification**.

2. The Director of OEP has delegated authority to take whatever steps are necessary to ensure the protection of life, health, property, and the environment during construction and operation of the Project. This authority shall allow:

   a. stop-work authority and authority to cease operation; and

   b. the design and implementation of any additional measures deemed necessary to assure continued compliance with the intent of the conditions of the Order.

3. **Prior to construction**, Aguirre LLC shall file an affirmative statement, certified by a senior company official, that all company personnel, EIs, and contractor personnel will be informed of the EI's authority and have been or will be trained on the implementation of the environmental mitigation measures appropriate to their jobs **before** becoming involved with construction and restoration activities.

4. The authorized facility locations shall be as depicted in the EIS, as supplemented by filed alignment sheets. **As soon as they are available, and before the start of construction**, Aguirre LLC shall file any revised detailed survey alignment maps/sheets at a scale not smaller than 1:6,000 with station positions for all facilities approved by the Order. All requests for modifications of environmental conditions of the Order or site-specific clearances must be written and must reference locations designated on these alignment maps/sheets.

5. Aguirre LLC shall file detailed alignment maps/sheets and aerial photographs at a scale not smaller than 1:6,000 identifying all route realignments or facility relocations, and staging areas, pipe storage yards, new access roads, and other areas that would be used or disturbed and have not been previously identified in filings. Approval for each of these areas must be explicitly requested in writing. For each area, the request must include a description of the existing land use/cover type, documentation of landowner approval, whether any cultural resources or federally listed threatened or endangered species would be affected, and whether any other environmentally sensitive areas are within or abutting the area. All areas shall be clearly identified on the maps/sheets/aerial photographs. Each area must be approved in writing by the Director of OEP **before construction in or near that area**.

   Examples of alterations requiring approval include all route realignments and facility location changes resulting from:

   a. implementation of cultural resources mitigation measures;

   b. implementation of endangered, threatened, or special concern species mitigation measures; and

   c. recommendations by state regulatory authorities.

6. **Within 60 days of the acceptance of the Authorization and before construction begins**, Aguirre LLC shall file an Implementation Plan for review and written approval by the Director of OEP. Aguirre LLC must file revisions to the plan as schedules change. The plan shall identify:

   a. how Aguirre LLC will implement the construction procedures and mitigation measures described in its application and supplements (including responses to staff data requests), identified in the EIS, and required by the Order;

b. how Aguirre LLC will incorporate these requirements into the contract bid documents, construction contracts (especially penalty clauses and specifications), and construction drawings so that the mitigation required at each site is clear to onsite construction and inspection personnel;

c. the number of EIs assigned, and how Aguirre LLC will ensure that sufficient personnel are available to implement the environmental mitigation;

d. company personnel, including EIs and contractors, who will receive copies of the appropriate material;

e. the location and date of the environmental compliance training and instructions Aguirre LLC will give to all personnel involved with construction and restoration (initial and refresher training as the Project progresses and personnel changes), with the opportunity for OEP staff to participate in the training session;

f. the company personnel (if known) and specific portion of Aguirre LLC' organization having responsibility for compliance;

g. the procedures (including use of contract penalties) Aguirre LLC will follow if noncompliance occurs; and

h. a Gantt or PERT chart (or similar project scheduling diagram), and dates for:

   i. the completion of all required surveys and reports;
   ii. the environmental compliance training of onsite personnel;
   iii. the start of construction; and
   iv. the start and completion of restoration.

7. Aguirre LLC shall employ one or more EIs. The EIs shall be:

   a. responsible for monitoring and ensuring compliance with all mitigation measures required by the Order and other grants, permits, certificates, or other authorizing documents;

   b. responsible for evaluating the construction contractor's implementation of the environmental mitigation measures required in the contract (see condition 6 above) and any other authorizing document;

   c. empowered to order correction of acts that violate the environmental conditions of the Order, and any other authorizing document;

   d. a full-time position, separate from all other activity inspectors;

   e. responsible for documenting compliance with the environmental conditions of the Order, as well as any environmental conditions/permit requirements imposed by other federal, state, or local agencies; and

   f. responsible for maintaining status reports.

8. Beginning with the filing of its Implementation Plan, Aguirre LLC shall file updated status reports **on a bi-weekly basis** until all construction and restoration activities are complete. On request, these status reports will also be provided to other federal and state agencies with permitting responsibilities. Status reports shall include:

   a. an update on Aguirre LLC's efforts to obtain the necessary federal authorizations;

   b. the current construction status at the Offshore GasPort site and of the pipeline, work planned for the following reporting period, and any schedule changes for work in environmentally sensitive areas;

   c. a listing of all problems encountered and each instance of noncompliance observed by the EI(s) during the reporting period (both for the conditions imposed by the Commission and any environmental conditions/permit requirements imposed by other federal, state, or local agencies);

   d. a description of corrective actions implemented in response to all instances of noncompliance, and their cost;

   e. the effectiveness of all corrective actions implemented;

   f. a description of any resident complaints which may relate to compliance with the requirements of the Order, and the measures taken to satisfy their concerns; and

   g. copies of any correspondence received by Aguirre LLC from other federal, state, or local permitting agencies concerning instances of noncompliance, and Aguirre LLC's response.

9. **Prior to receiving written authorization from the Director of OEP to commence construction of any Project facilities**, Aguirre LLC shall file documentation that they have received all applicable authorizations required under federal law (or evidence of waiver thereof).

10. Aguirre LLC must receive written authorization from the Director of OEP **prior to introducing hazardous fluids into the Project facilities**. Instrumentation and controls, hazard detection, hazard control, and security components/systems necessary for the safe introduction of such fluids shall be installed and functional.

11. Aguirre LLC must receive written authorization from the Director of OEP **before placing the Project into service**. Such authorization will only be granted following a determination that the facilities have been constructed in accordance with FERC approval and applicable standards, can be expected to operate safely as designed, and the rehabilitation and restoration of areas affected by the Project are proceeding satisfactorily.

12. **Within 30 days of placing the Authorized facilities in service**, Aguirre LLC shall file an affirmative statement certified by a senior company official:

   a. that the facilities have been constructed in compliance with all applicable conditions, and that continuing activities will be consistent with all applicable conditions; or

   b. identifying which of the authorization conditions Aguirre LLC has complied with or will comply with. This statement shall also identify any areas affected by the Project where compliance measures were not properly implemented, if not previously identified in filed status reports, and the reason for noncompliance.

13. Aguirre LLC shall file **with its Implementation Plan** the geotechnical analysis for the HDD of the Boca del Infierno pass and provide its assessment on whether the HDD would be a viable construction method for avoiding the pipeline's impacts on the coral reef habitat. To ensure impacts are minimized on the coral reef habitat, Aguirre LLC's assessment should discuss the feasibility of an HDD based on the substrate that would be crossed, including but not limited to mitigation measures such as the use of casings to minimize the likelihood of an inadvertent release, turbidity curtains to minimize sediment transport, and barges to collect drilling mud. If the HDD is not considered a viable construction method, Aguirre LLC shall use Alternative Route 6 to connect the Offshore GasPort to the Aguirre Plant. ***(Sections 3.6 and 4.5.2.4)***

14. **Prior to commencing final design**, Aguirre LLC shall file a revised Seismic Hazard Analysis Report that includes both the Great Southern Puerto Rico and Salinas Faults that is consistent with seismic details of the location and seismic characterization of these faults provided in the May 2014 Reclamation reports. Also, any design and seismic qualification documents that rely upon the current 2013 Golder Seismic Hazard Analysis Report ground motion values shall be revised to be consistent with the revised Seismic Hazard Analysis Report. (***Section 4.1.3.1)***

15. **Prior to construction**, Aguirre LLC shall file additional studies on the pipeline route seafloor slope angles and the liquefaction potential along the alignment, and provide any necessary mitigation measures based on these studies. These studies shall consider the revised seismic design ground motions that explicitly include the Great Southern Puerto Rico and Salinas Faults and consider both the Offshore GasPort location and the onshore terminus of the pipeline. ***(Section 4.1.3.2)***

16. **Prior to construction**, Aguirre LLC shall file the updated offshore wave analyses as indicated in Aguirre LLC's December 5, 2013 response to the FERC's November 15, 2013 Environmental Information Request (questions 6 and 7). This analysis shall be stamped and sealed by the professional engineer-of-record. ***(Section 4.1.4)***

17. **Prior to construction**, Aguirre LLC shall file the following information, stamped and sealed by the professional engineer-of-record:

    a. offshore berthing platform structures (including prefabricated and field constructed structures) and pile foundation design drawings and calculations. The offshore berthing platform structures and pile foundation designs shall incorporate criteria revisions agreed to by Aguirre LLC in its responses to FERC staff's June 17 and November 15, 2013 Environment Information Request;

    b. seismic specifications used in conjunction with the procuring equipment; and

    c. quality control procedures that would be used for design and construction.

    Aguirre LLC shall file the schedule for producing this information in its Implementation Plan. ***(Section 4.1.4)***

18. **During construction,** Aguirre LLC shall employ a special inspector. The special inspector shall be responsible for:

    a. observing the construction of the offshore berthing platform to be certain it conforms to the design drawings and specifications;

    b. furnishing inspection reports to the engineer or architect of record, and other designated persons. The inspection reports shall be summarized in **monthly** status reports and filed. All discrepancies shall be brought to the immediate attention of the contractor for correction, or if uncorrected, to the engineer or architect of record; and

    c. submitting a final signed report stating whether the work requiring special inspection was, to the best of his/her knowledge, in conformance with approved plans and specifications and the applicable workmanship provisions. A copy of the report shall be filed. ***(Section 4.1.4)***

19. **Prior to construction**, Aguirre LLC shall file a site-specific spill prevention and control plan for the construction and operation phases of the onshore and offshore portions of the Project for review and written approval by the Director of OEP. As part of the plan, Aguirre LLC shall include response measures that would be implemented if wildlife, including federally listed species or migratory birds, are impacted by an inadvertent hydrocarbon spill. ***(Sections 4.3.3.3 and 4.5.3.3)***

20. **During construction**, Aguirre LLC shall maintain the pipeline segments afloat and avoid contact with the seafloor outside the construction work area until the pipeline is ready for burial. (***Section 4.4.3)***

21. **Prior to construction,** Aguirre LLC shall consult with the NMFS, FWS, DNER, and other appropriate agencies to finalize the Benthic Resources Mitigation Plan to address the currently proposed construction and operation impacts and should include the actual pipeline design/route to be constructed. The plan shall address the seagrass that would be permanently impacted by shading due to the Offshore GasPort; a 5-year post-construction monitoring of the areas where the pipeline and/or concrete mats are above grade to determine if the mats are preventing the migration of conch, urchins, sea cucumbers, and other less mobile benthic organisms and identify measures, other than additional monitoring, that would be implemented if the mitigation sites are not trending towards successful restoration. In addition, the plan shall comply with the standard requirements found in the COE's Compensatory Mitigation Rule under the CWA Section 404 regulatory program. Aguirre LLC shall file its final Benthic Resources Mitigation Plan, along with agency comments, for review and written approval by the Director of OEP. ***(Sections 4.4.3 and 4.5.2.4)***

22. **Prior to construction**, Aguirre LLC shall consult with NMFS regarding the type of screen (e.g., wedge-wire) that will be used for hydrostatic test water withdrawals during the construction of the Project. The results of this consultation shall be filed for review and written approval by the Director of OEP. ***(Section 4.5.2.4)***

23. Aguirre LLC shall file **with its Implementation Plan** the protocol that it will use to determine the effectiveness of the turbidity curtains during construction. The protocol shall outline the monitoring that Aguirre LLC will conduct, thresholds that it will establish to define effectiveness, and the measures that it will implement if the turbidity curtains are ineffective. ***(Section 4.5.2.4)***

24. Aguirre LLC shall file **with its Implementation Plan,** a description of the measures that would be used, in addition to lowering the mat edges, to secure all the concrete mats to the seafloor. ***(Section 4.5.2.4)***

25. **Prior to construction,** Aguirre LLC shall coordinate with the FWS, NMFS, and DNER to develop a detailed MMO training and response protocol plan for the construction and operation phases of the Project. The plan shall provide appropriate measures to avoid and minimize potential vessel strikes of manatees and sea turtles and incorporate the FWS's manatee conservation measures for in-water work, where applicable. In addition, Aguirre LLC shall restrict the transit of crew boats during construction and operation to daytime trips to allow for the observation of marine mammals and decrease the potential for vessel strikes. The plan shall also require that travel speeds for Project construction-related vessels be reduced to no-wake (5 mph [4.3 knots]) levels, especially in waters shallower than 10 feet (3 m). In addition to the MMO plan, Aguirre LLC shall use aerial surveys to identify and assess impacts on the behavior of marine mammals and sea turtle proximate to the construction work areas. ***(Section 4.5.3.3)***

26. **Prior to construction**, Aguirre LLC shall verify that it would use confined bubble curtains when conducting vibratory and hammer pile activities in order to reduce impacts on marine wildlife species during construction of the Project. Aguirre LLC shall develop a detailed noise mitigation protocol for the safety exclusion zone (0.3 mile [0.5 km]) that identifies when the noise mitigation protocol would be implemented during construction and explains how each MMO would identify the limits of the exclusion zone. The protocol shall include the measures outlined in the FWS's draft EIS comment letter dated October 20, 2014. ***(Section 4.5.3.3)***

27. **Prior to construction**, Aguirre LLC shall file an assessment of potential noise impacts on resting and nesting birds during the construction (e.g., pile driving, vessels, and possible HDD) and operation of the Project, and identify mitigation measures that will be implemented to minimize or avoid these impacts. ***(Section 4.5.3.3)***

28. **Prior to construction**, Aguirre LLC shall develop a lighting plan that identifies specific measures that would be implemented to minimize or avoid impacts associated with the Project's operational nighttime lighting on avian species, fish species, marine mammals, various life stages of sea turtles, and individuals on the shoreline. The plan shall also analyze if the Project could artificially induce biological aggregations, and provide empirical evidence of how these potential aggregations could affect local fisheries and ecotourism. Aguirre LLC shall file this plan for review and written approval by the Director of the OEP. ***(Section 4.5.3.3)***

29. Aguirre LLC shall consult with the NMFS, FWS, DNER, and other appropriate agencies to develop mitigation measures for entrainment impacts of ichthyoplankton and coral larvae associated with Project operations and required water use. These measures shall include a 3-year study to analyze water intake impacts associated with Project operations. In addition, Aguirre LLC shall conduct an analysis of potential impingement impacts on Nassau grouper that are larger than larval size that may congregate near the seawater intakes at the Offshore GasPort. Aguirre LLC shall file the results of the grouper impingement analysis, the ichthyoplankton and coral larvae baseline survey results and monitoring plan, and the mitigation measures for entrainment impacts **prior to implementing Project operations**. Aguirre LLC shall also file the results of the 3-year water intake impacts study **when the analysis is complete.** ***(Section 4.5.4.3)***

30. Aguirre LLC shall not begin construction of the Project **until**:

   a. we receive comments from the FWS and NMFS regarding the proposed action;

   b. we complete any necessary Section 7 consultation with the FWS and NMFS, if required; and

   c. Aguirre LLC has received written notification from the Director of OEP that construction or use of mitigation may begin. ***(Section 4.6)***

31. **Prior to construction,** Aguirre LLC shall file a copy of the determination of consistency with the CZMP issued by the PRPB. ***(Section 4.7.3)***

32. **Prior to construction,** Aguirre LLC shall file a Construction Access Plan that clarifies all areas that it will restrict to marine users, clarifies the duration of any restriction, and identifies the methods of communication of restrictions to the general public. (***Section 4.7.7)***

33. Aguirre LLC shall file a noise survey **no later than 60 days** after placing the Aguirre Offshore GasPort Project in service. If a full load condition noise survey is not possible, Aguirre LLC shall provide an interim survey at the maximum possible load and provide the full load survey **within 6 months**. If the noise attributable to operation of the Offshore GasPort under interim or full load conditions exceeds an L_{dn} of 55 dBA at any nearby NSAs, Aguirre LLC shall file a report on what changes are needed and shall install additional noise controls to meet the level **within 1 year** of the in-service date. Aguirre LLC shall confirm compliance with the above requirement by filing a second noise survey **no later than 60 days** after it installs the additional noise controls. ***(Section 4.10.2.5)***

Information pertaining to these specific recommendations shall be filed for review and written approval by the Director of OEP either: **prior to any construction**; **prior to construction of final design**; **prior to commissioning**; **prior to introduction of hazardous fluids**; or **prior to commencement of service**, as indicated by each specific condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 683 (Docket No. RM06-24-000), including security information, shall be submitted as critical energy infrastructure information (CEII) pursuant to 18 CFR 388.112. See Critical Energy Infrastructure Information, Order No. 683, 71 FR 58,273 (October 3, 2006), FERC Stats. & Regs. 31,228 (2006). Information pertaining to items such as: offsite emergency response; procedures for public notification and evacuation; and construction and operating reporting requirements, will be subject to public disclosure. All information shall be filed **a minimum of 30 days** before approval to proceed is requested. ***(Section 4.11.3)***

34. **Prior to construction**, Aguirre LLC shall file the quality assurance and quality control procedures for construction activities. ***(Section 4.11.3)***

35. **Prior to construction**, Aguirre LLC shall file an overall Project schedule, which includes the proposed stages of the commissioning plan. ***(Section 4.11.3)***

36. **Prior to construction**, Aguirre LLC shall file a plot plan (area layout drawings) of the final design showing all major equipment, structures, buildings, and spill control systems. ***(Section 4.11.3)***

37. **Prior to construction**, Aguirre LLC shall file an ERP (including evacuation) and coordinate procedures with the USCG; Commonwealth and local emergency planning groups; fire departments; Commonwealth law enforcement; and appropriate federal agencies. This plan shall include at a minimum:

    a. designated contacts with Commonwealth and local emergency response agencies;

    b. scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;

    c. procedures for notifying residents and recreational users within areas of potential hazard;

    d. evacuation routes/methods for residents and public use areas that are within any transient hazard areas along the route of the LNG marine transit;

    e. locations of permanent sirens and other warning devices; and

    f. an "emergency coordinator" on each LNG vessel to activate sirens and other warning devices.

    Aguirre LLC shall notify the FERC staff of all planning meetings in advance and shall report progress on the development of its ERP **at 3-month intervals**. ***(Section 4.11.8)***

38. **Prior to construction**, Aguirre LLC shall file the ERP, which shall include a Cost-Sharing Plan identifying the mechanisms for funding all Project-specific security/emergency management costs that would be imposed on Commonwealth and local agencies. In addition to the funding of direct transit-related security/emergency management costs, this comprehensive plan shall include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. ***(Section 4.11.8)***

39. The **final design** shall provide a technical review of its proposed facility design that:

    a. identifies all combustion/ventilation air intake equipment and the distances to any possible hydrocarbon release (LNG, flammable refrigerants, flammable liquids, and flammable gases); and

    b. demonstrates that these areas are adequately covered by hazard detection devices and indicate how these devices would isolate or shutdown any combustion equipment whose continued operation could add to or sustain an emergency. ***(Section 4.11.3)***

40. **The final design** shall include change logs that list and explain any changes made from the Front-End Engineering Design provided in Aguirre LLC's application and filings. A list of all changes with an explanation for the design alteration shall be provided and all changes shall be clearly indicated on all diagrams and drawings. ***(Section 4.11.3)***

41. **The final design** shall provide up-to-date P&IDs, which include the following information:

    a. equipment tag number, name, size, duty, capacity, and design conditions;

    b. equipment insulation type and thickness;

    c. valve high pressure side and internal and external vent locations;

    d. piping with line number, piping class specification, size, and insulation type and thickness;

e. piping specification breaks and insulation limits;

f. all control and manual valves numbered;

g. relief valves with set points; and

h. drawing revision number and date. ***(Section 4.11.3)***

42. **The final design** shall provide an up-to-date complete equipment list, process and mechanical data sheets, and specifications. ***(Section 4.11.3)***

43. **The final design** shall provide complete drawings and a list of the hazard detection equipment. The drawings shall clearly show the location and elevation of all detection equipment. The list shall include the instrument tag number, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment. ***(Section 4.11.3)***

44. **The final design** shall provide complete plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Drawings shall clearly show the location by tag number of all fixed, wheeled, and hand-held extinguishers. The list shall include the equipment tag number, type, capacity, equipment covered, discharge rate, and automatic and manual remote signals initiating discharge of the units. ***(Section 4.11.3)***

45. **The final design** shall provide facility plans and drawings that show the location of the firewater system. Drawings shall clearly show: firewater piping and the location, and area covered by, each monitor, hydrant, deluge system, water-mist system, and sprinkler. The drawings shall also include piping and instrumentation diagrams of the firewater system. ***(Section 4.11.3)***

46. **The final design** shall include an updated fire protection evaluation of the proposed facilities carried out in accordance with the requirements of NFPA 59A 2013, chapter 12.2. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations shall be filed. ***(Section 4.11.3)***

47. **The final design** shall specify that, for hazardous fluids, the piping and piping nipples 2 inches or less in diameter are to be no less than Schedule 160 for carbon steel and no less than Schedule 80 for stainless steel, and are designed to withstand external loads, including operator live loads in areas accessible by operators. ***(Section 4.11.3)***

48. **The final design** shall provide electrical area classification drawings. ***(Section 4.11.3)***

49. **The final design** shall include a hazard and operability review of the completed design prior to issuing the P&IDs for construction. A copy of the review, a list of recommendations, and actions taken on the recommendations shall be filed. ***(Section 4.11.3)***

50. **The final design** shall include the cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system. The cause-and-effect matrices shall include alarms and shutdown functions, details of the voting and shutdown logic, and set points. ***(Section 4.11.3)***

51. **The final design** shall include a drawing showing the location of the emergency shutdown buttons. Emergency shutdown buttons shall be easily accessible, conspicuously labeled, and located in an area which would be accessible during an emergency. ***(Section 4.11.3)***

52. **The final design** shall include a plan for clean-out, dry-out, purging, and tightness testing. This plan shall address the requirements of the American Gas Association's Purging Principles and

Practice, and shall provide justification if not using an inert or non-flammable gas for cleanout, dry-out, purging, and tightness testing. ***(Section 4.11.3)***

53. **The final design** shall include the sizing basis and capacity for the final design of the vent stack and pressure relief valves for major process equipment and vessels. ***(Section 4.11.3)***

54. **The final design** shall provide the procedures for pressure/leak tests which address the requirements of ASME VIII and ASME B31.3. ***(Section 4.11.3)***

55. **The final design** flow rate of each firewater pump shall be based on the required firewater demand. ***(Section 4.11.3)***

56. **The final design** shall specify how the nitrogen purge piping to the vent stack would be used to extinguish an ignited vent. ***(Section 4.11.3)***

57. **Prior to commissioning**, Aguirre LLC shall file plans and detailed procedures for: testing the integrity of onsite mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service. ***(Section 4.11.3)***

58. **Prior to commissioning**, Aguirre LLC shall provide a detailed schedule for commissioning through equipment startup. The schedule shall include milestones for all procedures and tests to be completed: prior to introduction of hazardous fluids; and during commissioning and startup. Aguirre LLC shall file documentation certifying that each of these milestones has been completed before authorization to commence the next phase of commissioning and startup will be issued. ***(Section 4.11.3)***

59. **Prior to commissioning**, Aguirre LLC shall provide tag numbers on equipment and flow direction on piping. ***(Section 4.11.3)***

60. **Prior to commissioning**, Aguirre LLC shall tag all instrumentation and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves. ***(Section 4.11.3)***

61. **Prior to commissioning**, Aguirre LLC shall file the operation and maintenance procedures and manuals. ***(Section 4.11.3)***

62. **Prior to commissioning**, Aguirre LLC shall maintain a detailed training log to demonstrate that operating staff has completed the required training. ***(Section 4.11.3)***

63. **Prior to introduction of hazardous fluids**, Aguirre LLC shall complete a firewater pump acceptance test and firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant shall be shown on facility plot plan(s). ***(Section 4.11.3)***

64. **Prior to introduction of hazardous fluids**, Aguirre LLC shall complete all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the Distributed Control System and the Safety Instrumented System that demonstrates full functionality and operability of the system. ***(Section 4.11.3)***

65. **Prior to commencement of service**, Aguirre LLC shall file **monthly** reports of progress on the construction of the proposed systems. Details shall include a summary of activities, problems encountered, contractor non-conformance/deficiency logs, remedial actions taken, and current Project schedule. Problems of significant magnitude shall be reported to the FERC **within 24 hours**. ***(Section 4.11.3)***

66. **Prior to commencement of service**, Aguirre LLC shall file a plan for:

a. training frequency for operators;

b. testing frequency of facility components; and

c. record keeping for each training, equipment test, inspection or survey, and maintenance activity. ***(Section 4.11.3)***

67. **Prior to commencement of service**, Aguirre LLC shall receive written authorization from the Director of OEP at the Offshore GasPort. Such authorization will only be granted following a determination by the USCG, under its authorities under the Ports and Waterways Safety Act, the Magnuson Act, the Maritime Transportation Security Act of 2002, and the Safety and Accountability For Every Port Act, that appropriate measures to ensure the safety and security of the facility and the waterway have been put into place by Aguirre LLC or other appropriate parties. ***(Section 4.11.7.1)***

In addition, recommendations 68 to 71 shall apply **throughout the life of the facility**:

68. Aguirre LLC shall ensure that the FSRU moored at the offshore berthing platform would be in compliance with 46 CFR 154 and shall remain classed **throughout the life of the facility**. ***(Section 4.11.3)***

69. The facility shall be subject to regular FERC staff technical reviews and site inspections on at least an **annual basis** or at other intervals as determined by the Director of OEP. Prior to each FERC staff technical review and site inspection, Aguirre LLC shall respond to a specific data request, including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed piping and instrumentation diagrams reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted semi-annual report, shall be submitted. ***(Section 4.11.3)***

70. Semi-annual operational reports shall be filed to identify changes in facility design and operating conditions, abnormal operating experiences, activities (including ship arrivals, quantity and composition of imported LNG, vaporized quantities, boil-off/flash gas, etc.), facility modifications, including future plans and progress thereof. Abnormalities on the Offshore GasPort shall include, but not be limited to: hazardous conditions in associated cryogenic piping, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), hazardous fluids releases, fires involving hazardous fluids and/or from other sources. In addition, include unloading/loading/shipping problems, potential hazardous conditions from the FSRU or LNG carriers. Adverse weather conditions and the effect on the facility also shall be reported. Reports shall be submitted **within 45 days after each period ending June 30 and December 31**. In addition to the above items, a section entitled "Significant Plant Modifications Proposed for the Next 12 Months (dates)" also shall be included in the semi-annual operational reports. Such information would provide FERC staff with early notice of anticipated future construction/maintenance projects at the LNG facility. ***(Section 4.11.3)***

71. Significant non-scheduled events, including safety-related incidents (e.g., LNG or natural gas releases, fires, explosions, mechanical failures, unusual over pressurization, and major injuries) and security-related incidents shall be reported to FERC staff. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification shall be made **immediately**, without unduly interfering with any

necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification shall be made to FERC staff **within 24 hours**. This notification practice shall be incorporated into the LNG facility's emergency plan. Examples of reportable hazardous fluids related incidents include:

a. fire;

b. explosion;

c. estimated property damage of $50,000 or more;

d. death or personal injury necessitating in-patient hospitalization;

e. release of hazardous fluids for five minutes or more;

f. unintended movement or abnormal loading by environmental causes, such as an earthquake, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes hazardous fluids to rise above its MAOP (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure limiting or control devices;

i. a leak in an LNG facility that contains or processes hazardous fluids that constitutes an emergency;

j. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes hazardous fluids;

k. safety-related incidents to hazardous fluids vessels occurring at or en route to and from the LNG facility; or

l. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, FERC staff would determine the need for a separate follow-up report or follow-up in the upcoming semi-annual operational report. All company follow-up reports shall include investigation results and recommendations to minimize a reoccurrence of the incident. ***(Section 4.11.3)***